

NORTH CAROLINA  
GEOLOGICAL AND  
ECONOMIC SURVEY

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BIENNIAL REPORT 1919—1920

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, Director and State Geologist

BIENNIAL REPORT  
OF THE  
STATE GEOLOGIST

1919-1920



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1921





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## LETTER OF TRANSMITTAL

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CHAPEL HILL, N. C., December 30, 1920.

*To His Excellency, HON. T. W. BICKETT,  
Governor of North Carolina.*

SIR:—There is herewith submitted my biennial report on the operations of the North Carolina Geological and Economic Survey for the years 1919 and 1920.

Suggestions are made as to what legislation is considered necessary for carrying out more efficiently the duties that have been assigned to the Survey.

A financial statement covering the expenditures of the Survey for the past two fiscal years is also made a part of this report.

Yours respectfully,

JOSEPH HYDE PRATT,  
*Director.*



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# BIENNIAL REPORT OF THE STATE GEOLOGIST

On the Operations of the North Carolina Geological and Economic  
Survey for the Two Years Ending November 30, 1920.

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By JOSEPH HYDE PRATT, DIRECTOR

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## INTRODUCTION

The act establishing the present North Carolina Geological and Economic Survey was passed by the General Assembly of 1905 and amended by the General Assemblies of 1909 and 1917, and outlines in some detail the character and extent of the work to be undertaken and carried out by this department of the State. As stated in the act, the work is as follows:

1. The examination of the mineral, forest, fishery, and other resources of the State.
2. The examination of the geological formations of the State with reference to their economic products.
3. The examination of the road building materials and the best methods of utilizing same.\*
4. The examination and classification of the soils and forests and other physical features of the State, with special reference to their bearing upon the occupations of the people.
5. The examination of the streams and water powers of the State, with special reference to their development in manufacturing enterprises and the preservation of the sources of these streams through the protection of the forests.

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\* This is supplemented by an act passed by the General Assembly of 1909 which authorized the Geological Board to advise with the township and county authorities in the building and improvement of the public roads by sending to the township or county a competent road engineer who will assist them in locating their improved roads, advising them as to the best road to build and how to build it, and also give advice relating to the best kind of bridge to be built in connection with the improvement of any road. The Geological Board, through the State Geologist, may make inquiries in regard to systems of road building and management throughout the United States, and make investigations and experiments in regard to the best methods of road making and the best kind of road material, and shall disseminate such knowledge by lectures to be given in the different counties, and by preparing, publishing, and distributing bulletins and reports on the subject of road improvement, and shall also gather and tabulate information and statistics on road building in North Carolina and disseminate same throughout the State.



6. The examination of the water supplies of the State, with special reference to the sinking of deep artesian wells.

7. The investigation of the location, occurrence and development of mineral properties.

8. To provide for the prevention and control of forest fires in any and all parts of this State.

9. To coöperate with the several Federal Bureaus and such other sources as may assist in carrying out the provisions of this Act.

10. The preparation of reports giving the results of the investigations.

As will be seen from the above outline, the work of this department is very varied and extensive, and although it relates principally to the investigation, conservation, protection and development of the natural resources of the State, it touches the diverse interests of all sections of North Carolina and is of interest and value to every citizen of the State. With the appropriations that have been made for this work from year to year it has not been possible for the Survey to carry on all the work assigned to it, and it has been necessary for the Geological Board to determine which of the lines of activity were the most important to the people of the State, and these investigations have been carried on more extensively than some of the others. In some of the work, as in protection of forests from fire, the work has been limited to the amount of the appropriation for this particular purpose.

The Survey has, however, been very fortunate in receiving the heartiest coöperation of the various Federal Bureaus which have in many cases made liberal appropriations for coöperating with the State in many of its investigations; and in this way the work of this department has progressed much more rapidly than it could otherwise possibly have done. This relates particularly to the investigation of the swamp and overflowed lands of the State, the fisheries, water supplies and forestry.

The Survey has prepared for publication reports regarding its investigations, but the printing of these has often been delayed for several years, and in some instances the reports cannot be printed on account of lack of funds for printing same. As one of the principal works of the Survey is investigating the occurrence, quantity and value of the natural resources of the State and making reports for the people of the State on the results of these investigations, the General Assembly should make it possible for these reports to be published so that the people can obtain the results of the investigations which have been prepared for them. To be of the greatest value to the State these reports should be printed and be available for distribution at the time



when they will be of the most value either in conserving the interests of the people or in advertising our resources at the time when these resources are in most demand. Some of these reports, of course, have intrinsic value for all times, but some have a much greater value if they can be published as soon as the investigation is completed. Delay in publication may and often does mean the withholding of information which it has cost the State thousands of dollars to obtain, and it may cause the State to lose many more thousands of dollars because the information is not available for capitalists who are interested in investigating and developing at once the resources to which it refers. The demand for these reports on the natural resources of the State comes not only from the people of North Carolina but people from all over the country. If the investigations are of value to the State the results of the investigations are worth a great deal more to the State, but unless they are made available they are of little or no value.

The work of the Survey is grouped into divisions with an experienced investigator in charge of each division, as follows:

Administrative and Records Division, Joseph Hyde Pratt, Director.  
Geological and Mining Division, Wm. F. Prouty, Geologist.  
Forestry Division, J. S. Holmes, Forester.  
Water Resources Division, Thorndike Saville, Hydraulic Engineer.  
Drainage Division, Joseph Hyde Pratt, Engineer.  
Mapping Division, T. F. Hickerson, Engineer.  
Biological Division, W. C. Coker, Botanist.  
State Forests and Parks Division, Joseph Hyde Pratt, Director.

The work accomplished by the several divisions and suggestions for future work and investigations is described in detail under each head.

The personnel of the North Carolina Geological and Economic Survey for the past two years has consisted of the following, who have been employed either the whole or a part of their time:

Joseph Hyde Pratt, Director and State Geologist.  
J. S. Holmes, State Forester.  
W. D. Clark, Chief Forest Fire Warden.  
H. A. Carroll, Special Forestry Agent.  
D. L. Moser, Warden, Mitchell State Park.  
Wm. F. Prouty, Geologist.  
W. S. Bayley, Geologist.  
Jasper L. Stuckey, Geologist.  
Thorndike Saville, Hydraulic Engineer.  
T. F. Hickerson, Civil Engineer.  
Miss H. M. Berry, Secretary (To April 15, 1920).  
Miss Minnie Queen, Secretary.  
Miss Grace White, Stenographer.  
B. W. Sipe, Office Assistant.

*Forest Fire Wardens and Patrolmen:*—R. M. Fearson, W. J. Hardin, W. C. Gore, R. M. Bruton, Geo. F. Rhom, Ed. T. Shearer, C. H. Colvard, L. B. Murray, C. L. Wilson, Garland V. Stepp, Jas. F. Berry, Wm. R. Rice and Geo. F. Blair.

*Laborers on Mitchell Park:*—Fred Moser, David Moser, Artus Moser, William Fore and Charlie King.

*Surveyors and Assistants in Water Power Investigations:*—S. C. Austin, A. Y. Cottrell, Hall E. Cobb, E. S. Teague, H. Neville, G. L. Bean, Ned. Triplet, and Lynn Bean.

*Surveyors and Assistants in Topographic Mapping:*—L. W. Fischel, L. J. Phipps, R. E. Boyd, and Roy J. Morton.

*Temporary Clerks and Stenographers:*—Elizabeth Moses, Mrs. Laura Payne Mangum, Leona Priest, Mrs. T. J. Wilson, Mrs. K. J. Brown, Edith Skemp, Mildred Moses, Mrs. P. H. Winston, Margaret Berry, Mabel Thompson, Miss E. W. Marshall, Zan Koonce, Mrs. Elisabeth W. Baker, Lillian Long, I. B. Newman, Jesse R. Rhue, and Louise Coffey.

*Draftsmen:*—S. C. Austin, L. W. Fischel, and Roy J. Morton.

## GEOLOGICAL AND MINING DIVISION

### Geological Investigations

#### IRON ORES

The interest in the iron ores of the State which was stimulated during the war period has continued, and requests are constantly coming in for information as to the location of undeveloped deposits and producing mines. The present is perhaps the most opportune time in the history of the State for interesting capital in the iron ores of this State, particularly the magnetic iron ores of Ashe and Avery Counties and the brown ores of Cherokee County.

The iron ores of Western Piedmont and Western North Carolina have been investigated during the past two years by W. S. Bayley, Geologist, and to a less extent by the Director. Iron ores of Lincoln, Gaston and Madison Counties have also been investigated.

The following coöperative agreement was made between the U. S. Bureau of Mines and the State Survey in regard to investigating the methods of mining and concentrating iron ores of Cherokee County and the magnetic iron ores of Ashe and Avery Counties.

#### AGREEMENT BETWEEN THE BUREAU OF MINES AND THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

The Bureau of Mines (hereinafter referred to as the Bureau) and the North Carolina Geological and Economic Survey (hereinafter referred to as the Survey), desiring to carry on investigations relative to the method of mining, preparing for market, beneficiating and treatment of iron ores in the State of North Carolina, do hereby agree each with the other as follows:



1. The Bureau agrees to assign one of its mining engineers at a salary of forty-eight hundred dollars (\$4,800) per annum, to advise and assist the mine operatives in the State of North Carolina in the development of an improved method of mining, preparing for market, beneficiating and treatment of iron ores.

2. The Survey agrees to turn over all data it might have on hand bearing on this problem, and cooperate in any other way which might prove helpful to the solution of the problem herein contemplated.

3. The publication of the results of this investigation shall be under the control of the Director of the Bureau of Mines. Due recognition, however, shall be accorded to the Survey for its cooperation.

4. It is understood that this agreement, upon approval of the Secretary of the Interior, shall be effective from the 25th day of September, 1920, and may be terminated whenever in the judgment of the Bureau the provisions of this cooperative agreement have been accomplished.

U. S. BUREAU OF MINES, (Seal)

By F. G. COTTRELL, *Director*

NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY,

By JOSEPH HYDE PRATT (Seal)

*State Geologist and Director.*

Mr. Stanley E. Sears was appointed by the Bureau of Mines to make these investigations, and the results of his work will soon be available for publication.

#### STRUCTURAL MATERIALS

It was realized by the Geological Board early in 1920 that one of the vital and pressing needs of the State at the present time is an adequate local supply of structural materials, such as clay, stone, sand, gravel, etc., and in order to meet this need of the State an investigation was authorized to be made of the location, quantity and quality of such materials throughout the State. With this in view, Mr. Jasper L. Stuckey, Geologist, spent six months (1) investigating localities containing sands and gravels suitable for construction purposes and their preparation for market; (2) examining stone quarries and stone localities with special reference as to their becoming sources of supply of crushed stone for concrete and road purposes; (3) examining clay deposits with special reference as to their suitability for the manufacture of drain tile, vitrified brick and common brick.

The result of these investigations has shown that the State is well supplied with gravel deposits suitable for road surfacing material; and, when washed, for concrete; with stone suitable, when crushed, for use in concrete; that such deposits are to be found in many sections of the State, and many of them suitably located for quarrying. The



investigation has shown that the chief difficulty in contractors obtaining crushed stone from North Carolina deposits has been lack of cars for transportation. One or more quarries have had to close down completely because there was no way to ship their product. Others have had only a small proportion of the cars necessary to take care of the output of their crushing plants.

Special reports have been and are being prepared from Mr. Stuckey's investigations on properties for which this special information is desired, and these are being sent out as requests are received. A special report was prepared on road-building materials, and a portion of this has already been forwarded to the State Highway Commission.

#### GOLD AND COPPER

An examination was made by the Director of the Coggins Gold Mine, near Eldorado, Montgomery County, North Carolina.

Through the courtesy of Captain Theodore Earle, a mining engineer, and one of the Director's associates when he was Colonel of the 105th Engineers during the World War, some very interesting and valuable information has been obtained relating to the Ore Knob Copper Mine, of Ashe County. Captain Earle was in charge of the work when this old mine was unwatered and explored in 1915 and 1916. He believes from their investigations and tests that there is a large body of commercial grade copper ore in this mine. The information furnished by Captain Earle will be published in the Survey's report on the mining industry of 1920.

Through the courtesy of Mr. Thomas Smith, mining engineer, of Gold Hill, N. C., maps of the underground workings at the Union Copper Mine have been furnished the Survey which are additions to the maps published in the Survey's Bulletin 21 on the Gold Hill District. He has also furnished considerable new information regarding the geology of this district as exposed by these new underground workings. Information has also been given in regard to some new copper deposits that have been investigated near Moss Spring in Cabarrus County.

#### EXAMINATION OF MINERAL SPECIMENS

Mineral specimens are constantly being received at the Survey office for identification and analysis. Similar specimens received at the State Department of Agriculture are also forwarded to this office for the same purpose. Most of these do not represent anything of commercial or scientific value, but occasionally samples are received which

are of interest, and have led to development of commercial supplies of these minerals. The Survey makes no charge for such mineralogical determination, but when an assay or chemical analysis is considered worth while the Survey arranges, if desired, for such analysis to be made by the chemists to the Survey, for which a special charge is made. During the past two years 237 samples of minerals and rocks have been examined and reported upon by the Survey.

#### MINERAL STATISTICS

Coöperative arrangements have been made for several years with the U. S. Geological Survey for collecting statistics relating to the mineral production of North Carolina. For the year 1919, however, which was the census year, this work was done by the Bureau of the Census, and these figures are not yet available for the use of the State.

Arrangements have already been made with the U. S. Geological Survey to resume the coöperative agreement for collecting these statistics for 1920.

#### WORK OF U. S. GEOLOGICAL SURVEY AND U. S. BUREAU OF MINES IN NORTH CAROLINA DURING 1919 AND 1920

In addition to the coöperative work with the State Survey, which has already been mentioned, the U. S. Geological Survey has made some investigations in regard to chromite and mica, and these reports have been prepared for publication and will soon be ready for distribution. The Federal Survey has also assisted the State Survey in preparing the report on the Cretaceous formations of the Coastal Region of North Carolina.

A representative of the U. S. Bureau of Mines visited a number of the mica mines and mica trimming plants in North Carolina during April, 1919, to study methods of operation and possible problems in the industry. Two short papers have been issued by the Bureau dealing with mica problems.

A brief examination of some of the talc mines and talc grinding mills of North Carolina was made by one of the engineers of the Bureau of Mines in May, 1920. This work has been done in connection with the preparation of a general report on talc mining and milling.

#### FORESTRY DIVISION

The importance to North Carolina of her forests is strikingly shown by the fact that the forest industries produce material amount-



ing in value to at least one hundred million dollars per year and give employment to over fifty thousand men.

There are but few States in this country where the importance of the forests is relatively as great as in this State, where one-sixth of the entire wealth-producing capital is invested in forest lands or in industries directly dependent upon the products obtained from the forests. As a State we recognize that our furniture industry is absolutely dependent upon a permanent supply of hardwood; that the tanning industry, if it is to become a permanent one as it should, is dependent upon a constant supply of tanning material, as chestnut wood and hemlock and chestnut oak bark; and that the paper industry, which also should be a permanent one, is dependent upon a constant supply of pulp wood.

#### **Demand for Timber**

The wood-using industries of the State are second in value only to the cotton manufactures, and these factories, which turn out builders' supplies, furniture, vehicles, packing material, and many other things, obtained 96 per cent of their raw material from our own State. They complain, however, that the prices of this raw material are rising, the supply diminishing, and, what is worse still, the quality of the available timber rapidly declining.

During the past year 155 of the more important wood-using industries of the State have been visited and, according to statements obtained from the majority of these industries, their greatest need at present and in the future is a supply of suitable timber to be used in their plants. The statement was made at nearly all of the industries visited that the quality of their wood supply was not nearly as good as it was ten years ago, and that they were having to go constantly further for what they did obtain. One leading furniture manufacturer in the center of the State said: "The quality of grades has been lowered and still continues to be lowered. My production is off 50 per cent because of the scarcity of timber supply and labor." Representatives of at least one-third of these industries made the statement that their available supply of timber will be exhausted in ten or fifteen years.

With the shortage of timber there is an increase in price. Seven manufacturers, representing the eastern, central and western parts of North Carolina, state that the cost of their lumber supply has more than doubled during the past ten years, and that the quality of the supply is not nearly so good as it formerly was. One large furniture manufacturer said: "The supply is getting more scarce and price is



five times what it was five years ago. The quality of lumber which we got five years ago at \$30 per thousand was much better than what we now get at \$150 per thousand." Another manufacturer in the western part of the State writes: "Lumber we paid \$40 for in May, 1919, we paid \$248 for in May, 1920." Nearly all these industries report a shortage of raw material with a correspondingly large increase in its cost.

#### Present Condition

The forest area of North Carolina covers more than 20,000,000 acres, a very large part of which is steep, rough or poor land unsuitable for farming purposes. There are also about 2,000,000 acres of waste land in the State which have been lumbered and burned or cleared and found unprofitable to cultivate on account of roughness or erosion, which should be reforested. With this large area of timber land there was no thought given in the early history of the State to the question of a diminishing supply of forest products. The people of the State considered they had an inexhaustible supply, and therefore gave no thought as to how much they wasted in obtaining what they wanted or how much was destroyed by fire. No care was taken in lumbering to preserve seed trees and make it possible for the land to reforest itself to the best advantage. In lumbering no plan was considered with the end in view of the forests reproducing themselves with varieties of trees as valuable as the ones removed or that they would maintain a density so that the soil might produce its full capacity, or of even protecting the timber that still remained. Such methods of lumbering have finally brought us to the place where there is more woody material used or cut each year in North Carolina than the forests are replacing by the formation of new wood. Then, again, each year the forests become less capable of producing what is required of them. Their area contracts, less valuable trees take the place of the more valuable varieties which are cut, the soil becomes more impoverished and less able to yield large returns, and the demand for woody materials gradually increases with the increase in population.

*Timber Supply.*—There is given below an estimated amount and value of the standing timber and the young forest growth in North Carolina:

ESTIMATED AMOUNT AND VALUE OF STANDING TIMBER IN NORTH CAROLINA  
SUITABLE FOR SAW TIMBER, 1920.

Area Acres	Mountain Region	Piedmont Region	Coastal Plain Region	Total, State
Total areas, acres.....	4,150,000	12,850,000	14,190,000	31,190,000
Area forested.....	3,130,000	7,200,000	10,800,000	21,130,000
<i>Hardwood forest:</i>				
Area.....	2,800,000 <sup>a</sup>	4,200,000 <sup>c</sup>	2,500,000	9,500,000
Total stand, 1,000-ft.....	8,500,000	2,930,000	6,000,000	17,430,000
Value.....	\$ 42,000,000	\$ 14,650,000	\$ 24,000,000	\$ 80,650,000
<i>Softwood forest:</i>				
Area.....	300,000 <sup>b</sup>	2,400,000 <sup>d</sup>	8,300,000 <sup>f</sup>	11,000,000
Total stand, 1,000-ft.....	600,000	4,160,000	12,000,000	16,760,000
Value.....	\$ 6,000,000	\$ 20,000,000	\$ 60,000,000	\$ 86,000,000
Total stand, 1,000-ft.....	9,100,000	7,090,000	18,000,000	34,190,000
Total value.....	\$ 48,000,000	\$ 35,450,000	\$ 84,000,000	\$ 167,450,000

## NOTE:

- a. Includes mixed hardwood and softwood forests.
- b. Spruce forests only.
- c. Includes mixed hardwood and pine forests.
- d. Second growth or old field pine forests.
- e. Chiefly hardwood swamps.
- f. Includes both longleaf and shortleaf pine forests.

## ESTIMATED VALUE OF YOUNG FOREST GROWTH IN NORTH CAROLINA, 1920.

Area Acres	Mountain Region	Piedmont Region	Coastal Plain Region	Total, State
Total area, acres.....	4,150,000	12,850,000	14,190,000	31,190,000
Forested area.....	3,130,000	7,200,000	10,800,000	21,130,000
Hardwood forest area.....	2,800,000	4,200,000	2,500,000	9,500,000
Area not producing.....	300,000	200,000	-----	500,000
Merchantable timber area.....	1,000,000	1,000,000	1,200,000	3,200,000
Area young growth.....	2,500,000 <sup>a</sup>	4,000,000 <sup>a</sup>	1,300,000	7,800,000
Value young growth.....	\$ 37,500,000	\$ 60,000,000	\$ 13,000,000	\$ 110,500,000
Softwood forest area.....	300,000	2,400,000	8,300,000	11,000,000
Area not producing.....	260,000	160,000	3,300,000	3,720,000
Merchantable timber area.....	40,000	240,000	2,900,000	3,180,000
Area young growth.....	-----	2,000,000	2,100,000	4,100,000
Value young growth.....	-----	\$ 40,000,000	\$ 42,000,000	\$ 82,000,000
Total value young growth.....	\$ 37,500,000	100,000,000	55,000,000	192,500,000

## NOTE:

- a. Includes some areas on which there is mature timber.

As has been shown above, the forests represent one of the most valuable of the State's natural resources, but it is not being conserved as it should be nor protected in such a way that this valuable resource will be available to the extent that it should be for future generations.

The General Assembly of North Carolina has passed several very satisfactory acts relating to the conservation and perpetuation of our



forests, such as those relating to (1) a State forest fire protective system; (2) State-owned and operated demonstration forests and experimental stations; but has never made adequate appropriations for carrying out the purposes of these acts.

Protection of the forests from fire is a prerequisite for all other measures relating to the conservation and perpetuation of our forests. It is by far the most necessary and important measure for the State to extensively carry out, because the success of all others is dependent upon it. The principal object of such a measure is to prevent fires—not to wait until they are started and then extinguish them.

During the past ten years the damage done by forest fires is estimated at \$10,610,000. The distribution of this damage is shown in the following table:

## NORTH CAROLINA

Statement of damage by forest fires throughout the State for ten-year period 1910-1919, inclusive, as reported annually by township correspondents:

Total forested area of State, acres.....	20,000,000
Total number of acres of forest land burnt over.....	3,949,000
Total value timber destroyed.....	\$ 2,140,000
Total value young growth destroyed.....	\$ 3,591,000
Total value forest products destroyed.....	\$ 3,856,000
Total value improvements destroyed.....	\$ 1,023,000
Grand total value of all damage reported.....	\$10,610,000

The Forestry Division of the Survey is concentrating its work largely in protection of the forests under authority of the Act of 1911.

Patrolmen and fire wardens have been employed during the dangerous seasons in the following districts:

Mt. Mitchell District (Yancey and Buncombe Counties).  
 Linville District (Watauga, Avery and Caldwell Counties).  
 Tryon District (Polk County).  
 Sandhills District (Moore County).  
 Clay County District.  
 Wilkes County District.  
 Surry County District.  
 Southern McDowell County District.  
 Western Rutherford County District.  
 Southern Columbus County District.  
 Montgomery County District.  
 Southern Sampson County District.

In this work the Survey has had the coöperation of the U. S. Forest Service, the Linville Forest Protective Association, the Mt. Mitchell Forest Protective Association, the Camp Manufacturing Com-



pany, the Sandhills Fire Association, the Tryon Forestry Club, and Miles P. Flack.

With, however, the limited appropriation that the State makes for this work, and therefore the limited number of forest fire wardens and patrolmen that can be employed, the work cannot be made as effective as it will be when larger areas can be patrolled and sufficient funds will be available for utilizing the more extensive methods of protection, such as the construction of fire breaks, lookout towers, telephone lines, trails, etc.

#### Forest Fire Statistics

There are collected each year by this Division statistics relating to forest fires, their causes, area burned over, resulting damage, etc. The results of this investigation for the year 1918 and 1919 are given in the following table:

	1918	1919
Number of fires.....	1,135	1,359
Area burned over.....acres,	204,000	253,743
Standing timber destroyed (in M. ft.).....	22,000	23,989
Value of young growth destroyed.....	\$322,000	\$515,204
Total damage reported.....	\$858,000	\$1,258,076

This loss is a real loss to the State, but could in a large measure have been prevented by expenditure of a sum equal to but a very small per cent of the loss, and the coöperation of our courts, lumber companies, wood-using industries and the people of the State.

#### Protection of Watersheds

The reforestation and protection from fire of the many watersheds supplying water to our cities and towns is as yet not fully appreciated by our citizens, and particularly by our city councils. This applies particularly to those cities and towns whose water supply is obtained from streams within a large forested area which comprises the watershed. Such cities as Asheville are very fortunate to be able to obtain their water supply from a well-forested watershed, and it becomes a most valuable asset to the city. The protection of these watersheds from fire is, however, absolutely necessary in order to conserve the purity and quantity of the water. Many watersheds in the Piedmont area can be very much improved by the reforestation of the areas.

The Survey is assisting cities and towns in every way possible in planning for the reforestation and protection of their watersheds, but the amount that can be accomplished in this way is limited by the lack of realization of many of the commissioners of our cities and towns as to the need of the protection of their watersheds.

Any infraction of the regulations for the protection of watersheds should be severely punished. Recently several convictions were obtained by the City Council of Asheville for depredations on the Asheville watershed. The judges of our State courts should be informed of the seriousness of misdemeanors of this sort.

#### **Wood-using Industries**

The demand for information regarding the wood-using industries of the State and the supply of timber available for their uses has been steadily increasing of late years. Since the war it has been felt that a radical revision of the report on the wood-using industries was necessary. For this purpose an inquiry card was sent out to our list of wood-using industries the latter part of 1919. This inquiry was renewed in the spring and again in the summer of 1920. The Survey then secured the coöperation of the U. S. Forest Service in completing this study, and Mr. H. A. Carroll, of Rural Hall, N. C., was employed by the Survey during May and June, 1920, to travel over the State and secure what information was lacking to complete this study. The results of Mr. Carroll's study, together with the information previously secured, have been turned over to the Forest Service, and they are now compiling the data for a new report, which will shortly be ready for publication by the Survey. An introduction to this report dealing with the forest conditions of the State and the need of greater care in using and managing our timber resources will be added by the Survey.

#### **Study of Southern Pines**

At a meeting of the National Research Council held in Washington, D. C., October 4-5, the Survey was represented by the Forester. At this meeting it was determined to make a study of the growth and yield of the five important Southern pines throughout their range. The State Survey was asked, and has consented, to assist by securing information relating to longleaf pine in Eastern North Carolina, the Council agreeing to contribute \$300 towards the cost of this study. This will be done by the Forester early next spring. The results may be published by the Survey, provided the Research Council is supplied with all information obtained. The need for fuller information upon this subject has been felt by the Survey for a long time, and this opportunity of helping to secure it is gladly welcomed. The results of the whole study will be of enormous benefit to foresters and land-owners throughout all the Southern States.



### **Chestnut Bark Disease**

At the request of the Survey, the Division of Forest Pathology of the U. S. Department of Agriculture has made two field studies in the northeastern counties of the State to determine whether the chestnut bark disease had invaded North Carolina. Unfortunately, the disease was found scattered through three counties last spring, and a second and more extended scouting trip located infections in the following seven counties: Surry, Yadkin, Wilkes, Ashe, Watauga, Avery and Stokes. It is undoubtedly present also in Alleghany, and possibly in several other adjoining counties. This is the disease which has destroyed practically the entire stand of chestnut throughout the northeastern States, and which in an effort to eradicate it Pennsylvania spent \$275,000 without any success. The Federal expert says that it will probably be ten years before any very large proportion of our timber is killed, but he is of the opinion that within twenty years most of our chestnut will have been infected. There seems no remedy, but the duty of the Survey will be to urge as rapid and complete use of the dying and dead timber as possible.

### **North Carolina Forestry Association**

The State Survey has coöperated as in previous years with the North Carolina Forestry Association, and has practically had charge of arranging for the meetings of this Association. The Ninth Annual Convention was held in Raleigh on February 6, 1919; and the Tenth Annual Convention in Asheville, June 9th and 10th, 1920. The Forester of the Survey is secretary of the association. It is believed that the Forestry Association is one of the best mediums through which the people of the State can be informed in regard to forestry conditions and the need of protection and conservation of the forests.

In connection with the meeting of the Forestry Association held at Asheville, Mr. Henry Jewett Green, of Worcester, Mass., Vice President of the Appalachian Mountain Club, made a very forceful and enthusiastic talk on the work of this club, and what a chapter of the club could do for the Southern Appalachian region. This address was delivered at a banquet held at the Battery Park Hotel on June 10th. On June 11th a meeting was held in the Board of Trade rooms, at which Mr. Green was present, to take up the question of the organization of a Southern Chapter of the Appalachian Mountain Club. Sufficient applications were in to insure the required number of members, and the Chapter was officially organized and so declared by Mr. Green. Dr. Gaillard S. Tennant was elected secretary, and all previous corre-



spondence, applications for membership, etc., were turned over to him by the Forester, who had been working for the organization of the Chapter.

The Survey believes that through this club it will be able to advertise as never before the Southern Appalachian Mountains as a resort and will create through the club members and their friends a strong sentiment to protect the forests on these mountains. For this reason the Survey has taken a very live interest in the organization of this Chapter.

The Director of the Survey was president from 1916 through 1919 of the Southern Forestry Congress, which held its second convention in New Orleans, January 28-30, 1920. The Director was unable to attend this Congress, but the Survey was represented by the Forester, who was also secretary of the Congress, and was re-elected to that position. The Director was appointed chairman of the executive committee.

The Survey has also coöperated with the Society of American Foresters, the Appalachian Logging Congress, the North Carolina Pine Association, and the North Carolina Pine Box and Shook Manufacturers Association at their annual meetings by having a representative of the Survey present. The Director is a member of a committee of the Society of American Foresters which was appointed to consider national forestry legislation and to draft a bill covering such legislation. This bill as drafted has been approved by the society.

It is believed that such coöperative work of the Survey with these forestry associations is of inestimable value to the general forestry work in the State, and it enables the Survey to keep in direct touch with forestry problems that are coming up in other States and in the nation, the solving of which gives information that is beneficial in working out similar problems in this State.

#### **Work of the U. S. Forest Service in North Carolina During 1919-1920**

The State Survey has always had the most cordial coöperation from the Forest Service of the U. S. Department of Agriculture, and in addition to the coöperative work that they have taken up with the State Survey, the following statement from the Forester gives an idea of what has been done by the Forest Service relative to investigative and acquisition work in North Carolina:

*Forest Investigations.*—The forest investigations conducted by the Forest Service in North Carolina during the years 1919 and 1920 were in large part a continuation of earlier work and embraced three principal studies:

1. To determine the effect of past lumbering on the success or failure



of reproduction as a guide to future practice. This study is of fundamental importance since both the quality of the second growth and the financial returns secured depend upon employing the best method of cutting. The results already secured provide a tentative basis for the cutting of the present stands so as to secure the most profitable second growth. Much further work is, however, needed to secure conclusive results under the wide variety of conditions found in the State, and this will, therefore, probably continue to be one of the more important lines of investigation for years to come.

2. To determine the results of thinnings in forest plantations, permanent sample plots have been established on the Biltmore Estate, thinned, and left for subsequent thinnings and measurements at 5-year intervals. Valuable information as to the increase in rate of growth and the correspondingly increased financial returns resulting from different degrees of thinning will be secured from the first remeasurement of the plots due this coming summer, and increasingly valuable results will be secured with each subsequent remeasurement. The work is of great importance and should be extended experimentally on sample areas throughout the State and Southern Appalachian region.

3. To classify the various qualities of forest soil for the purpose of estimating the future growth and yield of stands on them, a simple plan for classification on the basis of height growth has been devised and will be tried out experimentally. The work is of direct practical value since the proper classification of forest lands is essential for successful forest management.

The investigative work already done is only a small part of what must be done to secure efficient, intelligent management of the forests, leading to their increased productivity. The additional work necessary can be accomplished most effectively by means of an adequately manned and supported forest experiment station. Senator Overman and Representative Weaver have introduced bills (S. 3558 and H. R. 11336) in Congress appropriating \$45,000 for the establishment of such a station in North Carolina in coöperation with the State and other agencies which may be interested. The passage of these bills would provide effectively for the additional studies which are urgently needed, and which, among other things, might include:

Reforestation of denuded spruce lands.

Reproduction of forest trees, involving studies of factors which determine the success of one or another species, such as their seed-bearing habits, seed germination, manner and vigor of sprouting, etc.

Early growth and competition of forest trees and forest weeds, involving the rate of growth, tolerance of shade, distribution, and seeding habits of many of the herbs, shrubs, and small weed trees as well as of the reproduction of desirable timber species.

Replacement with other species of chestnut, killed by the chestnut blight.

Methods of brush disposal, to determine the duration of serious fire hazard from pine or hardwood brush, variously disposed; whether and under what conditions burning is necessary; to what extent decay of brush will improve soil conditions; rate of decay, etc.



Rate of volume growth for different species and on different classes of land, to determine what species should be grown and what yields may be expected from them.

Effect of grazing by different kinds of stock and with different degrees of intensity on forest reproduction and on erosion.

Methods and effects of forest fire protection, to determine the best methods of fire protection and the probable increase in production as a result of such protection on the many areas of forest land which owe their present poor quality to repeated fires.

The entire problem of the best methods of handling forest and forest lands from planting the seed to cutting the mature timber is a vital one to North Carolina and the Southern Appalachian region. A forest experiment station is urgently needed to determine what those methods are.

*Economic and Industrial Investigations.*—During the spring of 1920 a rather hasty survey of the timber resources of the State was made by the Forest Service in connection with the collection of data on timber depletion throughout the country called for by Senate Resolution 311. This survey determined both for the yellow pine of the Coastal Plain and Piedmont regions and the hardwoods of the Appalachians the approximate area and amount of the present stand of timber, its rate of growth, and the probable future of the lumber industry in the different regions. It developed the fact that North Carolina, once famous as the "Longleaf Pine State," can now boast of scarcely 50,000 acres of second-growth longleaf pine, widely scattered in small areas, and that the old-growth hardwood timber will last hardly twenty years and will come from increasingly small operations. The seriousness of this situation is emphasized by the fact that, with the clearing for agricultural purposes of the rich bottomlands in the Lower Mississippi Valley, the country as a whole must look largely to the Southern Appalachians for its supply of large-sized, high-grade hardwood saw timber. Later in the year a further consideration of the pulpwood situation in North Carolina and elsewhere developed the fact that other regions are now looking more and more toward the Appalachian region for hardwoods for the manufacture of book paper, and that even in this region the industry is having to go farther and farther back into localities hitherto regarded as inaccessible for the raw material.

In the spring of 1920 the North Carolina Geological and Economic Survey entered into a cooperative agreement with the Forest Service with a view to collecting statistical information for use in the preparation of a revision of Economic Paper No. 20, entitled "Wood-Using Industries of North Carolina," which was published by the Survey in 1909. The work of collecting and tabulating the data has been completed and the report is now being written. It is expected that it will be ready for distribution in the late spring of 1921.

This report will show the extent to which lumber is further manufactured in the State. It will also indicate what industries of this kind exist, the kinds and quantities of woods used, the prices paid for them, and the classes of finished commodities into which they are converted. It will prove helpful in enabling both the Forest Service and the North Carolina Geological and Economic Survey to answer numerous requests for information from points in North Carolina and adjoining States concerning mar-



kets for various kinds of lumber and timber, wood uses, manufacturing processes followed in various wood-using industries, and wood waste utilization. In addition, it will aid the farmer, timberland owner, and sawmill operator in disposing of timber for which they desire to find a market through the presentation of information as to the kinds of wood used by different classes of manufacturers and the forms and prices applicable to such raw material. Wood-using factories will in turn be benefited by having these additional sources of supply for raw material brought to their attention. The report will also contain information helpful to manufacturers relating to various matters pertinent to their respective industries, such as the substitution of cheaper woods for the more costly ones now being used, regional sources of supply for raw material, etc.

One of the most striking facts brought out by these studies is the depletion of the raw material on which the wood-using industries are dependent for their continued existence. Thus practically all of the vehicle, furniture and chair manufacturers, referring to local supplies at present as compared with conditions existing during the past ten or twenty years, reported that these supplies have been greatly reduced. Looking forward to the next ten years, 22 per cent of the vehicle, 12 per cent of the furniture, and 43 per cent of the chair factories reported that supplies would be exhausted, and nearly all of the rest reported that they would be greatly reduced. Nothing could more clearly indicate the need for the perpetuation of the timber supplies of the State through the practice of forestry in order to insure the permanence of the wood-using industries and of the communities dependent on them.

*Acquisition to National Forests.*—In the fiscal year 1919, 3,016 acres were approved for purchase in North Carolina. During the fiscal year 1920, 4,701 acres were approved. The total area of all land acquired and being acquired in the State is 326,786 acres at an average value of \$6.24, representing a total purchase price of \$2,039,352.40.

### Suggested Forestry Legislation

The following forestry legislation which is considered necessary to carry out more effectively the forestry work of the Survey is submitted:

*The General Assembly of North Carolina do enact:*

SECTION 1. That the Board of County Commissioners of any county are hereby authorized and empowered, in their discretion, to coöperate with the North Carolina Geological and Economic Survey in the protection from fire of the forests within their respective counties, and to appropriate and pay out of the funds under their control for such protection an amount not to exceed one-half of the total expended by said Survey in such county during any one year for such protection; *Provided*, that said Board of County Commissioners may, in addition, agree with the Geological and Economic Survey to pay any part of or all the expenses incurred in extinguishing forest fires within said county after satisfying themselves that such expenses were legitimate and proper.

SECTION 2. All laws and clauses of laws in conflict with this act are hereby repealed.

SECTION 3. This act shall be in force on and after its ratification.



An act should also be passed relating to the elimination of special fire hazards and should empower the Geological Board to declare certain things, such as uncleaned railroad rights-of-way, and large accumulations of brush and slash adjoining municipal or other public lands to be special fire hazards; and those responsible for their condition should be required to clean them up so that they would not be a menace to the safety of neighboring property. It is applying similar regulations to forest lands as is applied by the Insurance Department to special fire hazards in connection with buildings.

### STATE FORESTS AND PARKS DIVISION

#### Mount Mitchell State Park

When the Mount Mitchell Park Commission was created by the General Assembly of 1919 and given charge of the Mount Mitchell State Park no appropriation was made for carrying on the work of protecting the forests on the park nor for its administration. At the request of the Governor and the Commission the State Survey has taken over the administration and protection of the park. Funds for carrying on this work have been obtained partly from the sale of dead timber on the park, by appropriation from the State Survey fund, and a loan from General Julian S. Carr, Chairman of the Mount Mitchell Park Commission.

At a joint meeting of the Mount Mitchell Park Commission and the Geological Board, held in Asheville on June 9th, 1920, it was decided that the best administration of the park would be secured by transferring it to the State Geological Board. The park has been carefully patrolled and forest fires have been pretty well eliminated from this area. As a protective measure the Survey is constructing as rapidly as possible a fire line or lane between the logging operations and the live timber on the park lands. As a result of the protective measures that have been in force since the park was created, it is estimated that the park has practically doubled in value since its purchase by the State.

Hundreds of people from all over the South have visited the park on foot during the past year, and more will be attracted each year; and it is believed that the State should make some provision for their comfort and convenience. A road that can be used by automobiles should be constructed by the State in coöperation with the U. S. Bureau of Public Roads and the U. S. Forest Service. The Chief Warden of the park has kept, as far as possible, a record of the visitors to the

park during the past year, and this record shows that the Park was visited by 742 people during the season of 1920 from the following States:

North Carolina—		Michigan .....	4
Middle .....	91	New Jersey .....	4
Western .....	134	District of Columbia.....	3
Eastern .....	31	Missouri .....	3
South Carolina .....	141	Ohio .....	3
Mississippi .....	56	Washington .....	2
Tennessee .....	50	West Virginia .....	2
Georgia .....	47	Maryland .....	2
Florida .....	40	Illinois .....	2
Virginia .....	29	Arkansas .....	1
Alabama .....	14	Connecticut .....	1
Kentucky .....	14	Indiana .....	1
Louisiana .....	12	Iowa .....	1
No address .....	11	Maine .....	1
Pennsylvania .....	9	Massachusetts .....	1
New York .....	9	Oregon .....	1
Texas .....	8	Wisconsin .....	1

#### FOREIGN COUNTRIES

Japan .....	5	Asia .....	1
Brazil .....	3	France .....	1
China .....	2	Switzerland .....	1

#### Camping Sites Along State Highways

With the increased construction of good roads throughout North Carolina and the whole Southern Appalachian region, Western North Carolina and the Piedmont section is becoming more and more available to tourists who are traveling by automobile. The time will come, and it may be very near, when it will be necessary for North Carolina to consider the question of providing public camping sites for such tourists. Several States have already taken up this question and are considering legislation authorizing the State to secure land at certain favorable locations along the highways which shall be public camping sites for tourists where they can camp for the night. This is going to become, it is believed, quite necessary in the mountain region. With a road constructed to Mount Mitchell Park, it becomes very necessary for the State to provide places along the road where the people can camp.

It is believed that the General Assembly of 1921 should pass an act relative to this question, and the following legislation is suggested:

That the State Highway Commission, the North Carolina Geological Survey and Boards of County Commissioners should be empowered



to acquire by purchase or gift parcels of land to be used as free public camping grounds;

That the location of these sites before purchase or acceptance by gift should be approved by the State Highway Commission, and that they should be along and contiguous to a State highway;

That in the selection of camping sites the topography of the land must be convenient for parking automobiles and other vehicles, with convenient water supply;

That rules and regulations governing the use by the public of such camping sites should be agreed upon by the State Highway Commission and the North Carolina Geological and Economic Survey;

That such camping sites purchased or accepted by gift on behalf of the State by the State Highway Commission and the North Carolina Geological and Economic Survey shall be administered by the North Carolina Geological and Economic Survey; those purchased or accepted by gifts by the Boards of County Commissioners shall be administered by said boards, but under such rules and regulations as may be determined by the State Highway Commission and the North Carolina Geological and Economic Survey;

That in selecting camping sites, in the mountain region particularly, larger areas than what would be necessary simply for parking automobiles may be secured, when by securing such additional land which is not suitable for parking automobiles, a scenic spot could be included or an advantage point for some particular view;

That a reasonable amount may be expended by the Boards of County Commissioners, the State Highway Commission and the North Carolina Geological and Economic Survey in fencing, when necessary, and otherwise improving such camping sites;

That it shall be a misdemeanor for any person to destroy any tree, deface any natural object, befoul any source of water supply located on or in any public camping site, or in any way to commit a nuisance on the camping site.

#### WATER RESOURCES DIVISION

The water resources of North Carolina are one of the most valuable of its natural resources, and include water powers and water supplies for cities and towns. These resources are being investigated under the following heads:

1. Water Supply for Cities and Towns.
2. Water Powers.
3. Protection of Watersheds.

During the year 1919 and the first six months of 1920 the principal work done in connection with the water resources of the State was the maintenance of gaging stations; but at its semi-annual meeting held in March, 1920, the Board decided to concentrate work on water resources. The following press notice, which was sent out soon after, gives a good idea of the character of the work that was taken up:

#### **A Water Resource Survey of the State**

At a recent meeting of the Geological Board it was decided that the North Carolina Geological and Economic Survey should begin at once a water resource survey of the State looking toward the development and utilization of our unused water powers and assisting municipalities or thickly settled rural communities in the acquirement of adequate water supplies and watersheds. The utilization of all available water power is especially desirable at the present time because of our rapidly growing manufacturing industries and industrial development, instances having arisen recently in this State of the abandonment of industries in certain communities because of their inability to secure power. Also the fuel situation is growing more and more acute, North Carolina having practically no coal supply and a rapidly diminishing supply of wood. The utilization of these water powers will do much toward conserving our fuel supplies and diminishing our coal bills.

Because of the rapid growth and expansion of many of the towns and cities of North Carolina, the local water supplies are proving inadequate, and resort must be had to acquiring or extending watersheds; or to obtaining new sources of supply.

To carry out this survey effectively will require the assembling of much data through the scientific study of the areas by competent engineers. Because of the small amount of funds at the disposal of the Survey for this work, the amount which can be undertaken during one field season is limited, and some financial coöperation will be expected from municipalities or individuals desiring such a survey in their vicinities.

Requests for assistance or surveys should be sent to the Director, North Carolina Geological and Economic Survey, Chapel Hill, N. C., and they will be considered in the order and importance of the application.

Blanks were prepared and sent to individuals, corporations and municipalities desiring assistance in regard to water power or water supply. The following is a copy of this contract blank:



## APPLICATION FOR INVESTIGATION

Applications for municipalities, manufacturers, or individuals desiring investigations or reports upon water powers, water supply, drainage, flood protection or irrigation should be accompanied by this form, properly filled out:

## GENERAL

1. Name of municipality, organization, or individual making application: .....
  2. Location of principal office of applicant:.....
  3. Location of district where investigation is desired:.....
  4. Character of desired investigation (water power, water supply, etc.): .....
  5. Describe in detail reasons for desired investigation:.....
  6. Is applicant prepared to pay, if necessary, 50% of the cost of the investigation? .....
- If investigation is for *Water Power*, answer following questions:
7. Name of stream to be investigated:.....
  8. Are any estimates of amount of stream flow or available fall known? .....
  9. How much power is it desired to develop?.....
  10. For what use is power desired?.....
  11. What is average distance from proposed development to where power will be used? .....
  12. Are there any existing power development in vicinity of proposed development? .....
  13. If electric power is now available in district, from whom is it purchased, or what is its source?.....
- If investigation is for *Municipal Water Supply*, answer following questions:
14. What is population of municipality?.....
  15. What is present source of water supply?.....
  16. What is character of local industries using large quantities of water? .....
- Name of applicant: .....
- Address: .....
- Signature of responsible organization or municipal official:.....
- Title: .....
- Date: .....

## WATER SUPPLY FOR CITIES AND TOWNS

The recent rapid growth of many North Carolina cities and towns has brought many of them upon the verge of a water shortage and several have appealed to the Geological Survey for aid in seeking and developing additional supplies. This need for information relating to the water supply is increasingly acute and the Survey is trying to prepare itself to meet it.

A special investigation has been made of the water supply for Carthage, Moore County, and a report with maps and profiles upon extension of their present water supply system has been prepared for the town. A special report was made for High Point upon the sufficiency of flow of the north branch of Deep River with reference to its possible use as a source of water supply for the city. A report has been prepared and submitted to the mayor of High Point, which also included suggestions for increasing the efficiency of the present plant. A complete water resources survey has been made of Wilkes and Surry Counties, which is described in more detail under Water Powers. The Commissioners of Buncombe County and the Board of Trade of Asheville have requested a water resources survey of Buncombe County.

The amount of work that the Survey can do along this line for the cities and towns of the State is entirely limited by the appropriation allotted for this purpose. There is an increasing demand for this work, and it is a phase of the operations of the Survey that is of great value to the cities and towns of North Carolina; and it is believed that the State should make this service available to all its cities and

## WATER POWERS

Under Water Powers the work has consisted of special examinations of certain streams as to available water power; county surveys for water powers and water supplies; conferences regarding the utilization of water power; installation of gaging stations; and measurement of flow of streams. Part of the stream measurement and installation of gaging stations has been in coöperation with the Water Resource Division of the U. S. Geological Survey through the Asheville office. The Federal Survey has loaned to the State Survey a complete outfit for measuring the flow of streams; and has also furnished several gages.

A water power investigation of Surry County was begun in July, 1920. One field party worked in this county until the latter part of



August, making river profiles and cross-sections of dam sites on the following streams:

Yadkin River,\*† Ararat River,\*† Fisher River,\*† Mitchell River, Elkin River.

A water power investigation of Wilkes County was begun the latter part of August and continued, with some interruption, until November 17. River profiles and cross sections of dam sites were made on the following streams, nomenclature being the same as in the preceding paragraph:

Elkin River, Roaring River, Reddies River, Lewis' Fork, Yadkin River.\*†

The survey did not include any streams or sites which could not be developed for at least 500 horsepower. Many of these streams have considerable fall in the upper reaches, but are of such low volume, especially in the summer months, that no considerable power could be depended upon, and no storage is available.

It is expected that these surveys will constitute a unit in the plan of a general State wide survey of the water powers. They were undertaken advisedly in sections which are relatively undeveloped, but which by the application of the existing water powers to generation of hydro-electric energy can be stimulated to great prosperity. It will be found that many of the powers are located within convenient distance of railway transportation, and the data provided in these reports should aid the exploitation of the region. Already, even before the publication of the reports, a number of requests have been made to the Survey for the data collected. This is notably the case with the Bean Shoals project, upon which the Ambursen Construction Company is now making an estimate for Winston-Salem interests. Requests have also been made for the data on the Ararat by Mount Airy and Pilot Mountain interests and on Fishers River by the owners of a site near Dobson. Similar requests have already been made for the results of the work in Wilkes County. Altogether, it is quite evident that there is much demand for this information.

The Chamber of Commerce of Fayetteville requested the Survey to make a report upon the best location for hydro-electric development to supply electricity to Fayetteville. This was rendered necessary by the great dearth of power in that city and the inability of existing power companies to remedy it. The Chamber of Commerce agreed to

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\* Gaging stations were established on these streams.

† Storage studies of one or more selected sites were made on these streams.

pay one-half the expenses of the survey and report. After a preliminary reconnaissance by the Hydraulic Engineer, Smiley's Falls on the Cape Fear River near Lillington was selected as the most promising site. A field party conducted a detailed survey here for about two weeks, and a complete report has been rendered the Chamber of Commerce of Fayetteville. This power is one of the best not yet developed in this section of the State, and it is greatly to be hoped that it may be utilized before long. It is estimated that there is available a continuous 24-hour power of 10,000 horsepower, and a 10-hour power, with the pondage, of 24,000 horsepower. With the large markets of Fayetteville and Raleigh relatively near there seems every incentive present for development.

An investigation has also been made of the power at Glenn's Mills, on the Deep River, near Glendon. It seems probable that this may be developed before long. There are several good power sites on this river, and a gaging station has been established at Glendon. This work has led to a request for a proposition from the Survey for a water power survey of Moore County.

*Gaging Stations:*—The State Survey is coöperating with the Federal Survey in operating gaging stations and in making discharge measurements on several streams and rivers in Western and Piedmont North Carolina. This work is now done from the joint office of the Federal Survey and the State Survey which was located in Asheville, N. C., in September, 1920. Mr. Warren E. Hall, District Engineer for the Federal Survey, is in charge of the Asheville office, and this work of measuring streams is under his direction. The following gaging stations have been in operation during the past two years, in addition to those already mentioned:

Hiwassee River, Murphy, N. C., Cherokee County; Nottely River, Ranger, N. C., Cherokee County; French Broad River, Asheville, N. C., Buncombe County; Yadkin River, Donnahoe, N. C., Forsyth County; Yadkin River, Salisbury, N. C., Rowan County; Catawba River, Rhodhiss, N. C., Caldwell County.

The Survey has recently, in coöperation with the U. S. Geological Survey, established a model stream gaging station on Morgan's Creek near Chapel Hill, Orange County. In connection with this station a survey is being made with some exactitude of the area of the watershed. The purpose of this station is threefold: (a) to furnish opportunity for experiments in stream gaging methods and for the improvement of present apparatus; (b) to obtain discharge measurements from a small Piedmont stream; in order to have data relating to such streams which is now lacking and for which a demand exists in this and adjoin-



ing States; (c) to furnish opportunity for experimental work and instruction in hydraulic measurements by engineering students at the University, from whom the State and U. S. Surveys recruit their forces, and who often become connected with the hydro-electric companies of the State.

There are many problems affecting the measurement, storage and use of water in this State, concerning which it is hoped to prosecute investigations at this station. Among these are the subjects of rate of silting of reservoirs; the relation of intensity of rainfall to runoff and influence of the forest cover; the testing of hydraulic apparatus; methods of channel control and regulation, etc.

Morgan's Creek is particularly well adapted for such experiments as its characteristics simulate closely those of rivers of the Piedmont and Coastal Plain. It is, however, small enough to handle in an experimental way, and large enough to make the results of such experiments applicable to larger streams.

The experimental use of this stream could be greatly enhanced if a hydraulic laboratory were located upon it in conjunction with the model gaging station. It would then be possible not only to carry on experimental work with a far higher degree of precision, but to test water wheels, to perform experiments on the flow of water over dams, to study the best methods of filtration and purification of southern waters, and to train men intensively for service with the hydro-electric companies and municipalities of the State.

Such a laboratory is not only of great value to the work and investigations of the State and Federal Surveys but is really a necessary adjunct to the teaching of hydraulics and water power engineering in the University.

*Coöperation with War Department:*—Congress has made an appropriation for a survey of the water powers and others resources of the Tennessee River and its tributaries. Through Major Harold C. Fiske, District Engineer for the War Department, to whom this work has been assigned, a method of coöperation has been arranged with the Water Resources Division of the U. S. Geological Survey and the North Carolina Geological and Economic Survey, and Mr. Warren E. Hall, Hydraulic Engineer, who is in charge of the Asheville office, will have general charge of the water resources work in Western North Carolina.

The primary object of this War Department survey in regard to the water resources is to obtain stream flow data that will be useful in making studies relating to water powers, storage, and floods. The data and information as collected will be forwarded to the War Depart-

ment District Engineers' office at Chattanooga, but arrangements are being made so that this information will be available for the State Survey as it is desired. It is possible that all this information for Western North Carolina will go through the Asheville office and be copied there before sending the cards and slips to the Chattanooga office.

### WATER POWER STATISTICS

The Survey is trying to keep in touch with the development of water powers throughout the State, the utilization of this water power, the percentage of power used in the State that is derived from water powers, etc. Through the medium of State papers, the Manufacturers' Record, engineering journals, and letters from correspondents the Survey is able to obtain the names of individuals and corporations who are undertaking the development and utilization of water powers. In order to obtain the information that the State should have regarding the power development in the State a power census is being undertaken by the Survey in coöperation with the U. S. Geological Survey, beginning in January, 1921. The following power census blank will be sent out to all developers of power in the State. The information obtained will be utilized not only by the two Surveys, but by the State Department of Labor and Printing.

### POWER CENSUS

The power situation in North Carolina has become so serious, the dearth of power to meet our growing industrial expansion is so great, and accurate data as to exact power is so meagre, that the State Geological and Economic Survey is conducting a power census of the State. This census is preliminary to a detailed investigation and report upon the undeveloped water powers of the State, field work in which is already under way. The success of this attempt to outline the power needs of the State and to present figures and necessary information as to undeveloped sites, is dependent upon a 100 per cent response to this questionnaire upon the part of all municipalities, manufacturers, or individuals to whom it is sent. Your coöperation is earnestly requested in a matter which is of vital concern to the growth of the State at this time.

*If requested, the data given below will be held in absolute confidence, and used only by the Survey in investigating the general power situation and determining localities in which to concentrate its activities to obtain more power.*

Kindly answer as many as possible of the questions below and return form in the stamped addressed envelope that is enclosed.

Name of municipality, concern or individual.....  
 Location:..... County..... Town (City) of.....  
 Class of goods manufactured (such as cotton, general power, flour, etc.)..  
 .....  
 Power: Steam: Coal.....H. P.  
                   Oil .....H. P.  
           Water .....H. P.  
           Electricity: .....H. P.  
           Gasoline: .....H. P.  
           Crude Oil (Diesel Type): .....H. P.



*If steam power is used, answer following questions:*

Railroad serving plant: .....  
 Distance from railroad to plant: .....  
 Does coal or oil have to be hauled from railroad to plant? .....  
     If so, are auto trucks used? .....  
 Number tons coal used per year: .....tons  
 Number gallons oil used per year: .....gallons

*If water-power is used, answer following questions:*

Name of stream developed: .....River; (near) (at) .....N. C.  
 Type of development:

Overshot or undershot wheel: Make.....; No.....  
     Diameter.....; Setting.....; Power.....H.P.  
 Turbines: Make.....; No.....; Diameter.....;  
     Setting (vertical or horizontal); Power.....H. P.  
 Impulse wheel: Make.....; No.....; Diameter.....;  
     Setting.....; Power.....H. P.  
 Head: No. of feet head under operating conditions varies from.....  
     .....feet to .....feet  
 Discharge of wheels: Under operating conditions varies from.....  
     .....sec.-ft. to .....sec.-ft.

Dam: Height above stream bed.....feet  
     Top width .....feet  
     Concrete-gravity .....(Answer yes or no)  
     Concrete-arch.....(Answer yes or no)  
     Concrete-reinforced (hollow).....(Answer yes or no)  
     Masonry-rubble .....(Answer yes or no)  
     Masonry-ashlar .....(Answer yes or no)  
     Earth .....(Answer yes or no)  
     Wood-log and rock.....(Answer yes or no)  
     Wood-timber crib.....(Answer yes or no)

Water carriage, if any:

Flume, length.....ft.; slopes.....ft. per 100; area.....sq. ft.  
 Pipe, wood stave: length.....ft.; diameter.....ft.  
 Pipe, steel: length.....ft.; diameter.....ft.  
 Other conveyance: .....

Spillway: Character and location.....  
 Discharge provided for .....sec.-ft.

Drive: Are water wheels connected through gears direct to machinery?..  
     Are water wheels direct connected to electric generators?.....

If so, answer following questions:

Make of generator: .....  
 Size: .....K. V. A.....  
 Voltage generated .....volts  
 Voltage transmitted .....volts  
 Voltage used .....volts

*If electric power is used, answer the following questions:*

Is machinery driven in whole or in part by individual electric motors?....  
 Is power generated by you?.....  
 If not, from what company is power purchased?.....  
 Do you need more power? .....

How much? .....H. P.

Are you able to purchase it from the company now supplying you?.....

Additional Power:

Are you increasing your power plant at present?.....

If so, how much H. P., and by what means (steam, water, hydro-electric, etc.) .....

Do you desire to develop more hydro-electric power?.....

How much? .....H. P.

Can you enlarge your present hydro-electric or water-power plant for this purpose? .....

If not, is there an undeveloped site near you?.....

Do you desire information from the North Carolina Geological and Economic Survey as to possible hydro-electric sites near your present establishment? .....

Are you interested in obtaining information as to undeveloped sites in other districts? .....

If so, are you interested in any particular locality?.....

#### ADMINISTRATION OF WATER POWERS

The creation of the Federal Power Commission has brought to a focus many matters relative to water power control and administration. This Commission is authorized to issue permits for all water power developments upon navigable streams or the headwaters thereof. The general consensus of opinion seems to be that the Federal Power Commission has the authority to absolutely regulate and control every development of any character on any stream in the United States which is itself navigable or is tributary to a navigable stream. This power is tremendously sweeping, and might work grave injustice to the State were their rights not safeguarded by the provision that nothing within the act, nor any decision of the Commission shall be construed as affecting the laws of the respective States relating to the use and control of water, and that all decisions of the Commission are made subject to the prior rules and regulations of the State bodies charged with the administration of the State power resources, *provided that where the State has no such body, or any such laws, that the Federal Power Commission will then in effect administer the surface water resources of the State.*

Under the provisions of this act if the State Geological Survey has the power to control either the construction of dams or the regulation of streams within the domain of the State, then the Federal Power Commission does not control; but, lacking State legislation relating to the control and administration of the water resources of the State, the Federal Power Commission is empowered to administer these State resources.



As is seen from the above, if the State does not pass the necessary legislation to control and conserve its water powers, then the Federal Government will.

The Federal Power Commission is also charged with the rate regulation of hydro-electric companies where the State has no rate-making body. In North Carolina the State Corporation Commission is charged with this duty, but it has no means of obtaining information upon which to base its rates. A power company presents arguments for an increase in rates, and the Corporation Commission has no information of its own as to what the actual valuation of the applicant company is, what its income is, what its normal capacity is, or whether it can produce more power if needed. Some State body is thus essential to function as an agent to collect statistics as to water power development and installation for the benefit of the Corporation Commission.

The Federal Power Commission is directed to give preference to municipalities in issuing permits for water power development. It is expected that all applications for water power permits will first go to a State Commission—which will notify any municipalities in case developments are planned in their vicinity, so that they may have the first opportunity to obtain a permit. It is the duty of such a State body to canvass the situation in the State and keep informed of the power needs of the various municipalities. North Carolina has no such body authorized to do this; but with authority and funds the State Survey is in a position to take charge of this work.

Similarly the Power Commission must give preference in the issuing of permits to States which themselves contemplate water power developments. Several States—notably California and South Dakota—have undertaken to construct hydro-electric developments. The New York Conservation Commission has urged very strongly the construction by the State of large developments, and the subsequent leasing to private corporations for operation. The province of Ontario has empowered a Commission to construct and operate all the hydro-electric developments in the Province, with the result that every little rural hamlet gets electric power from one of the many radiating lines at from 2c. to 5c. per kilowatt hour—about half that charged just across the border in New York State.

#### **DRAINAGE AND RECLAMATION DIVISION**

The drainage work in North Carolina readily divides itself into four heads: (1) Drainage of the swamp lands in the Coastal Plain region; (2) Reclamation of overflowed lands in the Piedmont region;

(3) Tile drainage of the reclaimed lands; and (4) Bringing settlers to take up these reclaimed lands in the Coastal Plain region.

The work under 1 and 2 readily belongs to that of the Geological and Economic Survey. The work under 3 is that of the Agricultural Department, and that under 4 of both the Survey and the Agricultural Department.

1. *Drainage of Swamp Lands in the Coastal Plain Region.*—There are now approximately 600,000 acres of land that formerly was swamp areas valued at from 25c. to \$2 as a maximum per acre, and was not listed at more than an average of 50c. per acre. These lands are now worth from \$50 to \$100 or more per acre. As stated by Congressman John H. Small in an address before the North Carolina Drainage Association at Washington, N. C.: "I presume it is a fair statement to make that the market value, upon an average, of these lands today is \$50 an acre, and \$50 times 600,000 acres is \$30,000,000; so that there has been added to the assets of the State lands which heretofore were not worth more than \$600,000 or certainly \$1,200,000, which are now worth at least \$30,000,000. Any public movement which can set forth to the people of the State an increment to the economic wealth of our people to that extent is entitled to the favorable consideration of the people of North Carolina." This reclamation of the swamp lands is one of the most successful accomplishments of the Survey, and it can be justly proud of adding this large asset to the State.

The Drainage Law, which has made this work possible, has been the model for drainage legislation in Virginia, South Carolina, Georgia and Florida.

2. *Reclamation of Overflowed Lands in the Piedmont Section.*—The same law governing the drainage of the swamp lands of Eastern North Carolina is applicable to the reclamation of the overflowed lands of the Piedmont section. Here again, the Survey has been very successful in assisting in the organization and carrying through of drainage districts. Many acres in these Piedmont counties have been reclaimed and brought into cultivation, and these lands have become a valuable asset to the State, where formerly they were practically non-productive.

4. *Bringing Settlers to take up these Reclaimed Lands in the Coastal Plain Region.*—One of the large problems that now confronts the State in connection with the reclamation of the swamp lands is bringing them under cultivation. It is believed that the Survey can be of very great assistance in this work by establishing a publicity bureau which, by means of newspaper articles, addresses before agricultural



conventions, agricultural expositions, and similar meetings, can bring before the people of this country the extent and value of these reclaimed lands. While at the present time there is a good deal of newspaper comment upon the vacant farms in many of our States, due to the people leaving the farms and going into cities and towns, yet there is a very large demand throughout the country as a whole for farms, the land of which is productive and easily cultivated. I believe it will be found, upon investigation, that the greater proportion of the farms abandoned are those where the returns are small and the cultivation of the farm is difficult, such as the rocky farms of portions of New England and New York and the worn-out lands of certain of the Piedmont sections. I believe that if we can bring to the notice of those people who want productive farm lands that we have some of the most fertile land of the country on these reclaimed areas of Eastern North Carolina; that the purest drinking water can be obtained on these farms in the form of artesian water; that they have good railway and water transportation; that they are traversed by good roads; that good schools are available for the children; and that the climate is good throughout the year, it will not be very difficult to bring the right class of people to take up these lands.

The North Carolina Drainage Association is a medium through which the Survey can keep in touch with the people of the State in regard to drainage. The annual meeting of this Association was held at Washington, N. C., March 31 and April 1, 1920, and was attended by delegates from 25 counties. Other delegates and guests present were from Ohio, Maryland, Virginia, Massachusetts, Georgia, South Carolina and District of Columbia. The Association re-elected the Director of the Survey Secretary and Treasurer. The preparations for this meeting were made by the Survey. A great many interesting and valuable papers were read and discussed at the convention, and the report of the meeting has been published as Economic Paper No. 50 of the Survey's publications.

In connection with the War Department work in Western North Carolina there will be investigated the question of flood prevention on the French Broad River. If the plans materialize it will include the construction of the dam and lake mentioned under Water Powers. Delegations from Hendersonville, and Henderson and Transylvania Counties are having conferences with the War Department engineers in regard to this project.

At the National Drainage Congress which was held in Atlanta, Georgia, November 10-12, 1920, the Survey was represented by Mr. Will D. Alexander, Drainage Engineer of Charlotte, N. C. The

Director of the Survey has been appointed a member of the Board of Governors of the National Congress.

### BIOLOGICAL DIVISION

This division of the Survey, which has recently been organized, will be under the direct supervision of Dr. W. C. Coker, Professor of Botany of the University of North Carolina. Arrangements have already been made for the preparation of a volume on "The Plants of North Carolina." A volume on mushrooms, by Dr. Coker, is nearly completed, and it is hoped that this can be published during the coming year.

This division will take up investigations in regard to the value of game fish in Western North Carolina. Very little effort has been made to determine what is the actual value to the State of North Carolina of its waters from the standpoint of the game fish that they contain. The Federal Government, through its hatcheries, is ready to coöperate with any State in stocking waters with fish. From the tourist standpoint fishing in the mountain streams is a very great asset, and it is believed that with little effort the Federal Government could be induced to establish a hatchery in Western North Carolina. It is also believed that the State would find that it would be a good investment for her to establish a hatchery. There is no doubt that one of the biggest attractions to many who seek the mountains for recreation is the fishing.

The Director of the Survey is taking up with the Chief of the Bureau of Biological Survey the question of a coöperative agreement between the two Surveys whereby a biological survey of North Carolina can be conducted. While pretty exhaustive investigations have been made of the fishes and birds of the State, which have been published as Volumes II and IV, respectively, of the Survey's publications, but little work has been done in regard to the mammals of this State; and it is hoped that the U. S. Bureau will be able to assist the State in making such a survey.

The U. S. Bureau of Fisheries, with which the Survey has coöperated for the past twenty years in investigating the fisheries of the State, has during the past two years carried on considerable work in North Carolina, as follows:

*Beaufort Laboratory.*—The Beaufort Laboratory, which is located on an island near Beaufort, Carteret County, North Carolina, was established in 1897 through the efforts of the North Carolina Geological and Economic Survey and the University of North Carolina. A temporary



station was first established for the investigation of the marine fauna and flora of the southern coast. Prof. H. V. Wilson of the University was appointed director, and for the next three years he and the late Dr. J. A. Holmes, who was then Director of the North Carolina Geological and Economic Survey, devoted much time and thought to its development. Congress finally made an appropriation for the establishment of a permanent laboratory, but made no appropriation for the purchase of a site. Arrangements were made by the Survey for the purchase of the present site and its donation to the Government. Since that time the State Survey has kept in close touch with the work at the Laboratory, and they have coöperated in investigating many problems relating to the cultivation of the oyster, clam, and terrapin.

This Laboratory, which was taken over and occupied by the Navy in January, 1918, was only turned back to the U. S. Bureau of Fisheries shortly after the beginning of the fiscal year 1920; so that but little work has been done by the Laboratory during the past two years. The Director of the Laboratory and three assistants, each of the latter for short periods, have devoted themselves to the preparation of an extensive report on the results of the experimental work on the propagation of the diamond-back terrapin. Attention has been given also to a study of a bacterial disease of the winter-fed yearling terrapin of the experimental broods. One temporary investigator has been engaged in the study of the life histories of crabs of the Beaufort region.

Investigations were made of salinity conditions in Currituck Sound as affected by the Chesapeake and Albemarle Canal.

*Fishery Industries*—This division of the Bureau, in addition to collecting statistics relating to the fishing industry, makes investigations and recommendations in regard to utilization of fish and preparation of fish for market.

The Bureau has urged those in the menhaden industry having hot-air dryers to manufacture fish meal for feeding hogs, cattle and poultry, as well as fish scrap for fertilizer; and, through the Bureau of Animal Industry, has arranged for feeding tests to show the value of this feed as compared with other protein feeds. (See Bureau of Fisheries Document 892, pages 11-13.)

The Bureau has recently completed an investigation on the salting of fish which developed an improved method of salting fish in warm climates and should be of interest to North Carolina fishermen. (See Bureau of Fisheries Document 884 and Document 892.)

As a result of the Bureau's efforts to establish a fishery for sharks, and the utilization of all its parts, a number of fisheries have been established, including one at Morehead City, N. C. (See Bureau of

Fisheries Document 892, page 19—fish oils; page 13—fish, leather and shark fins.)

*Fish Planted in North Carolina.*—The U. S. Bureau of Fisheries maintains a fish hatchery at Edenton, Chowan County, at which were hatched large-mouthed black bass, shad, sunfish, yellow perch and white perch; and a small hatchery at Weldon, Halifax County, which is part of the Edenton station, at which striped bass are hatched. The output of the Edenton station for the fiscal years 1919 and 1920 is given in the following table:

OUTPUT OF EDENTON STATION, FISCAL YEARS 1919-1920

	1919	1920
Large-mouthed black bass.....	23,585	36,310
Shad .....	23,694,000	16,286,000*
Striped bass .....	13,540,000	16,474,000*
Sunfish .....	12,700	6,250
White perch .....	2,035,000*	.....
Yellow perch .....	114*	.....

In addition to the fish planted from the Edenton station, quite a number of fish were planted during the fiscal years 1919 and 1920 as given in the following tables:

FISH PLANTED IN NORTH CAROLINA WATERS BY THE BUREAU OF FISHERIES  
DURING FISCAL YEAR 1919

Location	Name of Water	Species	Number
Badin.....	Tallassee Lake.....	catfish .....	30
Burnsville.....	Bay Mine Lake.....	catfish .....	300
Corinth.....	Buckhorn Pond.....	catfish .....	30
Pee Dee.....	Blewett Falls Lake.....	catfish .....	30
Raleigh.....	Milburnie Pond.....	catfish .....	30
Statesville.....	Catawba River.....	catfish .....	1,500
Monroe.....	Shute's Pond.....	carp .....	15
Bessemer City.....	Toms Creek Lake.....	rainbow trout.....	10,000
Black Mountain.....	Long Branch.....	rainbow trout.....	4,000
Black Mountain.....	Swannanoa River, N. Fork.....	rainbow trout.....	10,000
Black Mountain.....	Swannanoa River, Sugar Fork.....	rainbow trout.....	4,000
Boone.....	Howard Creek.....	rainbow trout.....	1,000
Cranberry.....	Blevins Creek.....	rainbow trout.....	1,000
Ela.....	Cooper Creek.....	rainbow trout.....	4,000
Ela.....	Little Creek.....	rainbow trout.....	4,000
Ela.....	Newton Mill Creek.....	rainbow trout.....	4,000
Elk Park.....	Blevins Creek.....	rainbow trout.....	15,000
Elk Park.....	Elk River.....	rainbow trout.....	3,600
Elk Park.....	Little Elk Creek.....	rainbow trout.....	8,400
Franklin.....	Rabbit Creek.....	rainbow trout.....	3,750
Green Mountain.....	Toe River.....	rainbow trout.....	4,500

\* NOTE.—Indicates fry, all others are fingerlings.



FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Horseshoe.....	Mills River.....	rainbow trout.....	7,000
Hot Springs.....	Little Creek.....	rainbow trout.....	6,000
Hot Springs.....	Long Branch.....	rainbow trout.....	4,000
Lansing.....	Big Horse Creek.....	rainbow trout.....	4,000
Lansing.....	Little Horse Creek.....	rainbow trout.....	3,500
Lenoir.....	Gragg Creek.....	rainbow trout.....	2,000
Lenoir.....	Roek House Creek.....	rainbow trout.....	1,000
Lenoir.....	Wilson Creek.....	rainbow trout.....	2,500
Lenoir.....	Yadkin River.....	rainbow trout.....	6,000
Linville Falls.....	Linville River.....	rainbow trout.....	1,500
Marshville.....	Thomas Pond.....	rainbow trout.....	5,000
Mieaville.....	Loeust Creek.....	rainbow trout.....	6,000
Mieaville.....	South Toe River.....	rainbow trout.....	10,500
Montezuma.....	Linville River.....	rainbow trout.....	5,000
North Wilkesboro.....	Reddies River.....	rainbow trout.....	7,200
Pickens.....	Estatoe Creek.....	rainbow trout.....	7,500
Pickens.....	White Water River.....	rainbow trout.....	7,500
Poplar.....	Flat Branch.....	rainbow trout.....	4,500
Spruce Pine.....	Grassy Creek.....	rainbow trout.....	4,000
Tuxedo.....	Cabin Creek.....	rainbow trout.....	6,250
Tuxedo.....	Green River.....	rainbow trout.....	16,250
Tuxedo.....	Roek Creek.....	rainbow trout.....	3,750
Waynesville.....	McElory Creek.....	rainbow trout.....	4,000
Asheville.....	Mineral Creek.....	brook trout.....	10,500
Canton.....	Crawford Creek.....	brook trout.....	6,000
Canton.....	Daniels Creek.....	brook trout.....	6,000
Dillard.....	Big Creek.....	brook trout.....	5,400
Dillard.....	Mill Creek.....	brook trout.....	3,600
Dillard.....	Satulah Creek.....	brook trout.....	3,600
Dillard.....	Shoal Creek.....	brook trout.....	3,600
Dillard.....	Slab Camp Branch.....	brook trout.....	3,600
Dillard.....	Wildeat Lake.....	brook trout.....	3,600
Ela.....	Cooper Creek.....	brook trout.....	3,000
Ela.....	Little Creek.....	brook trout.....	3,000
Etowah.....	Willow Creek, South Prong.....	brook trout.....	4,500
Foscoe.....	Dixon Creek.....	brook trout.....	6,000
Horseshoe.....	North Mills River and branches.....	brook trout.....	17,500
Lake Toxaway.....	Bear Wallow Creek.....	brook trout.....	11,400
Lake Toxaway.....	French Broad River, East Fork.....	brook trout.....	7,200
Lake Toxaway.....	Indian Creek.....	brook trout.....	4,500
Lake Toxaway.....	Shoal Creek.....	brook trout.....	4,500
Lenoir.....	Anthony Creek.....	brook trout.....	10,500
Lenoir.....	Lost Cove Creek.....	brook trout.....	3,000
Linville.....	Big Grassy Creek.....	brook trout.....	5,000
Linville.....	Grandmother Creek.....	brook trout.....	6,000
Linville.....	Kawana Lake.....	brook trout.....	3,000
Linville.....	Linville River.....	brook trout.....	10,000
Linville.....	Linville River, West Fork.....	brook trout.....	5,000
Linville.....	Little Grassy Creek.....	brook trout.....	5,000
Mieaville.....	South Toe River.....	brook trout.....	8,000
Newland.....	Squirrel Creek.....	brook trout.....	6,000
Pisgah Forest.....	Davidson River and branches.....	brook trout.....	26,000
Pisgah Forest.....	South Mills River.....	brook trout.....	26,500
Poplar.....	Pigeon Roost Creek.....	brook trout.....	7,500
Samareand.....	Drowning Creek, middle branch.....	brook trout.....	5,400
Tuxedo.....	Grassy Creek.....	brook trout.....	5,400
Tuxedo.....	Grassy Creek Briar Fork.....	brook trout.....	5,400
Tuxedo.....	Jims Creek.....	brook trout.....	5,400
Angier.....	Spring Branch.....	crappie.....	200

FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Battleboro.....	Davis' Pond.....	crappie.....	200
Bryson City.....	Tuckaseegee River.....	crappie.....	400
Burlington.....	South Piedmont Pond.....	crappie.....	203
Franklinton.....	Seven Springs Pond.....	crappie.....	200
Greensboro.....	Cool Spring Pond.....	crappie.....	300
Greensboro.....	Cunningham Mill Pond.....	crappie.....	300
Hickory.....	Cliffs Lake.....	crappie.....	200
High Point.....	Furlo gh Lake.....	crappie.....	500
Kinston.....	Jericho Pond.....	crappie.....	400
Littleton.....	Warren Pond.....	crappie.....	500
Marshville.....	Fairview Pond.....	crappie.....	100
Pendleton.....	Stephenson-Skye Mill Pond.....	crappie.....	400
Raleigh.....	Lakewood Pond.....	crappie.....	400
Raleigh.....	Neuseoco Club Lake.....	crappie.....	600
Rosindale.....	Clark Mill Pond.....	crappie.....	300
Aberdeen.....	Marie Pond.....	largemouth black bass ..	*2,000
Aberdeen.....	Sand Hill Lake.....	largemouth black bass ..	3,000
Asheboro.....	City Pond.....	largemouth black bass ..	400
Bayboro.....	Bay River.....	largemouth black bass ..	*400
Bostic.....	Rocky Broad River.....	largemouth black bass ..	450
Burlington.....	Dickey's Pond.....	largemouth black bass ..	1,500
Burlington.....	Sartin Mill Pond.....	largemouth black bass ..	1,500
Burlington.....	Old Willow Brook Pond.....	largemouth black bass ..	1,500
Burlington.....	Silver Lake.....	largemouth black bass ..	1,500
Burlington.....	Stinking Quarter Pond.....	largemouth black bass ..	1,400
Burlington.....	Walker's Pond.....	largemouth black bass ..	1,400
Calypso.....	Sutton's Pond.....	largemouth black bass ..	200
Cary.....	Holleman's Pond.....	largemouth black bass ..	200
Charlotte.....	Catawba River.....	largemouth black bass ..	1,750
Clinton.....	Great Coharie Creek.....	largemouth black bass ..	120
Clinton.....	Six Runs.....	largemouth black bass ..	120
Corinth.....	Yarborough's Pond.....	largemouth black bass ..	*400
Dunn.....	Jernigan's Pond.....	largemouth black bass ..	400
Dunn.....	Smith Mill Pond.....	largemouth black bass ..	600
Durham.....	Angier Pond.....	largemouth black bass ..	300
Durham.....	Car enter Pond.....	largemouth black bass ..	275
Durham.....	Wilbon Pond.....	largemouth black bass ..	300
Elkin.....	Carter Falls Pond.....	largemouth black bass ..	200
Elkin.....	Elkin River.....	largemouth black bass ..	225
Ellerbe.....	Howell's Pond.....	largemouth black bass ..	2,000
Ellerbe.....	Quick's Pond.....	largemouth black bass ..	2,000
Fayetteville.....	Marrison's Pond.....	largemouth black bass ..	400
Flat Rock.....	King's Pond.....	largemouth black bass ..	2,000
Flat Rock.....	Ottaray Lake.....	largemouth black bass ..	3,000
Flat Rock.....	Smythe's Pond.....	largemouth black bass ..	4,000
Graham.....	Pine Hill Pond.....	largemouth black bass ..	600
Graham.....	Thompson Pond.....	largemouth black bass ..	100
Greensboro.....	Revolution Pond.....	largemouth black bass ..	3,300
Greensboro.....	Seminole Pond.....	largemouth black bass ..	4,100
Havelock.....	East Creek.....	largemouth black bass ..	1,350
Hendersonville.....	Bane's Pond.....	largemouth black bass ..	100
Hendersonville.....	Few's Pond.....	largemouth black bass ..	300
Hendersonville.....	Hayne's Pond.....	largemouth black bass ..	500
Hendersonville.....	Maybank's Pond.....	largemouth black bass ..	300
Hendersonville.....	Scheppergrell's Pond.....	largemouth black bass ..	300
Hendersonville.....	Vincent's Pond.....	largemouth black bass ..	300
Hickory.....	Catawba River, Henry's Fork.....	largemouth black bass ..	100

\*NOTE—Indicates fry, all others are fingerlings.



FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Hickory.....	Catawba River, Jacob's Fork.....	largemouth black bass..	100
High Point.....	Walnut Branch Pond.....	largemouth black bass..	600
Kinston.....	Jericho Pond.....	largemouth black bass..	400
Knightdale.....	Mill Pond.....	largemouth black bass..	400
Lenoir.....	Buffalo Creek.....	largemouth black bass..	100
Marble.....	Hyatt's Creek.....	largemouth black bass..	3,000
Marble.....	Valley River.....	largemouth black bass..	3,000
Marion.....	Big Buck Creek.....	largemouth black bass..	100
Marion.....	Brown Mill Pond.....	largemouth black bass..	100
Marion.....	Catawba River.....	largemouth black bass..	100
Marion.....	Little Buck Creek.....	largemouth black bass..	100
Marion.....	Lofte Mill Pond.....	largemouth black bass..	100
Marion.....	Morgan's Pond.....	largemouth black bass..	100
Marshville.....	Austin's Pond.....	largemouth black bass..	700
Marshville.....	Lanes Creek.....	largemouth black bass..	450
Marshville.....	Sim's son's Pond.....	largemouth black bass..	1,400
Mount Airy.....	Minnick's Pond.....	largemouth black bass..	3,400
New Bern.....	Brice's Creek.....	largemouth black bass..	900
New Bern.....	Neuse River.....	largemouth black bass..	1,100
New Bern.....	Trent River.....	largemouth black bass..	1,100
Newport.....	Lake Oxley.....	largemouth black bass..	*200
Newton.....	Pinchgut Creek Pond.....	largemouth black bass..	200
Norlina.....	Watson's Pond.....	largemouth black bass..	200
Princeton.....	Holt' Pond.....	largemouth black bass..	600
Raeford.....	Beaverdam Pond.....	largemouth black bass..	400
Raleigh.....	Boone's Pond.....	largemouth black bass..	400
Raleigh.....	Doctor's Lake(A).....	largemouth black bass..	400
Raleigh.....	Doctor's Lake(B).....	largemouth black bass..	400
Raleigh.....	Ne seoco Club Lake.....	largemouth black bass..	200
Randleman.....	Bull un Pond.....	largemouth black bass..	200
Riefeld.....	Morgan's Pond.....	largemouth black bass..	100
Salisbury.....	Graf's Pond.....	largemouth black bass..	100
Samareand.....	Drowning Creek.....	largemouth black bass..	4,000
Samareand.....	La' e Tamarlane.....	largemouth black bass..	2,000
Shulls Mills.....	Wa a ga River.....	largemouth black bass..	1,700
Smithfield.....	Holt's Lake.....	largemouth black bass..	1,300
Stokesdale.....	Enoch's Pond.....	largemouth black bass..	300
Sylvia.....	Cullowhee Creek.....	largemouth black bass..	2,000
Sylvia.....	Scott Creek.....	largemouth black bass..	2,000
Sylvia.....	Tuckasegee River.....	largemouth black bass..	5,000
Sylvia.....	Tuckasege River, Left Fork.....	largemouth black bass..	3,000
Sylvia.....	Tuckasegee River, Right Fork.....	largemouth black bass..	3,000
Tarboro.....	Fishing Creek.....	largemouth black bass..	400
Tarboro.....	Lake Parks.....	l rgemouth black bass..	400
Tarboro.....	Tar River.....	largemouth black bass..	400
Warren Plains.....	Dillard's Pond.....	largemouth black bass..	*200
Warren Plains.....	Tharrington's Pond.....	largemouth black bass..	*200
Washington.....	Broad Creek.....	largemouth black bass..	200
Washington.....	Chocowinity Bay.....	largemouth black bass..	600
Washington.....	Chocowinity Creek.....	largemouth black bass..	600
Washington.....	Respass Mill Pond.....	largemouth black bass..	600
Washington.....	Upper Broad Creek.....	largemouth black bass..	600
Winston-Salem.....	Ariston Pond.....	largemouth black bass..	2,800
Woodside.....	Lake Lilv.....	largemouth black bass..	*200
Youngsville.....	Moores Pond.....	largemouth black bass..	*400
Etowah.....	Bluff Pond.....	smallmouth black bass..	100
Lenoir.....	Buffalo Creek Pond.....	smallmouth black bass..	200

\*NOTE—Indicates fry, all others are fingerlings.

## FISH PLANTED IN NORTH CAROLINA WATERS—Continued

Location	Name of Water	Species	Number
Rutherfordton.....	Coxe's Pond.....	smallmouth black bass..	450
Rutherfordton.....	Green River.....	smallmouth black bass..	900
Rutherfordton.....	Green River Lake.....	smallmouth black bass..	450
Rutherfordton.....	Upper Broad River.....	smallmouth black bass..	925
Hendersonville.....	Imbersley Pond.....	rock bass.....	500
Norlina.....	Fleming Pond.....	rock bass.....	400
Norlina.....	Large Pond.....	rock bass.....	350
Norlina.....	Lee's Pond.....	rock bass.....	325
Norlina.....	Owen's Creek Pond.....	rock bass.....	400
Norlina.....	Roger's Lake.....	rock bass.....	325
Norlina.....	Shocco Lake.....	rock bass.....	500
North Wilkesboro.....	Hendren's Pond.....	rock bass.....	550
North Wilkesboro.....	Reddie's Pond.....	rock bass.....	1,000
Raleigh.....	Doctor's Lake.....	rock bass.....	500
Raleigh.....	Hood Mill Pond.....	rock bass.....	500
Raleigh.....	Milburnie Pond.....	rock bass.....	400
Raleigh.....	Neusecco Club Pond.....	rock bass.....	3,750
Raleigh.....	Peachtree Pond.....	rock bass.....	1,000
Rural Hall.....	Petree's Pond.....	rock bass.....	500
Smithfield.....	Holt's Lake.....	rock bass.....	600
Woodside.....	Lake Lottie.....	rock bass.....	300
Badin.....	Tallahassee Lake.....	sunfish (bream).....	2,000
Benson.....	Hardee's Pond.....	sunfish (bream).....	200
Bessemer City.....	Beaverdam Pond.....	sunfish (bream).....	400
Bryson City.....	Tuckasee River.....	sunfish (bream).....	800
Burlington.....	Big Alamance Pond.....	sunfish (bream).....	500
Burlington.....	Little Alamance Pond.....	sunfish (bream).....	500
Burlington.....	Moser Mill Pond.....	sunfish (bream).....	400
Burlington.....	Stony Creek Pond.....	sunfish (bream).....	500
Cary.....	Jones' Pond.....	sunfish (bream).....	200
Cary.....	Knight's Pond.....	sunfish (bream).....	200
Clayton.....	Hinton's Pond.....	sunfish (bream).....	200
Clinton.....	Mill Pond.....	sunfish (bream).....	300
Corinth.....	Buckhorn Pond.....	sunfish (bream).....	400
Elkin.....	Iaster's Pond.....	sunfish (bream).....	500
Fayetteville.....	Bonnie Brook Pond.....	sunfish (bream).....	400
Garner.....	Wilder's Pond.....	sunfish (bream).....	200
Goldsboro.....	Little River.....	sunfish (bream).....	500
Goldsboro.....	Wood's Mill Pond.....	sunfish (bream).....	300
Graham.....	Clapp's Pond.....	sunfish (bream).....	400
Greensboro.....	Lakewood Farm Pond.....	sunfish (bream).....	500
Hazelwood.....	Welch's Pond.....	sunfish (bream).....	200
Hope Mills.....	Parker's Pond.....	sunfish (bream).....	600
Julian.....	Chockley Pond.....	sunfish (bream).....	500
Kinston.....	Kennedy's Mill Pond.....	sunfish (bream).....	250
Kittrell.....	Clear Pond.....	sunfish (bream).....	100
Knightsdale.....	Willow Club Pond.....	sunfish (bream).....	300
Liberty.....	Major Hill Pond.....	sunfish (bream).....	500
Louisburg.....	Jones Mill Pond.....	sunfish (bream).....	300
Lumberton.....	McMillen Pond.....	sunfish (bream).....	400
Lumberton.....	Mine Creek Pond.....	sunfish (bream).....	400
Macesfield.....	Warren's Pond.....	sunfish (bream).....	200
Marshville.....	Marsh's Pond.....	sunfish (bream).....	200
Marshville.....	Moore's Pond.....	sunfish (bream).....	200
Mayodan.....	Balsam's Pond.....	sunfish (bream).....	500
Maysville.....	White Oak River.....	sunfish (bream).....	1,300
Morven.....	Martin's Pond.....	sunfish (bream).....	600
Morven.....	Williamson's Pond.....	sunfish (bream).....	800
Mount Airy.....	Brooks Pond.....	sunfish (bream).....	1,000



FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Nashville.....	May's Pond.....	sunfish (bream).....	400
North Wilkesboro....	Hendren's Pond.....	sunfish (bream).....	900
Pee Dee.....	Blewett Falls Pond.....	sunfish (bream).....	1,800
Pittsboro.....	Hinton's Pond.....	sunfish (bream).....	200
Pittsboro.....	Nooe's Pond.....	sunfish (bream).....	100
Potecasi.....	Hicks Mill Pond.....	sunfish (bream).....	400
Raleigh.....	Hinton's Creek Pond.....	sunfish (bream).....	300
Raleigh.....	Milburnie Pond.....	sunfish (bream).....	300
Raleigh.....	Neuseoco Club Pond.....	sunfish (bream).....	1,000
Roseboro.....	Willow Oaks Pond.....	sunfish (bream).....	200
Ruffin.....	Cox's Pond.....	sunfish (bream).....	500
Salisbury.....	Harkey Pond.....	sunfish (bream).....	500
Statesville.....	Beechwood Pond.....	sunfish (bream).....	500
Washington.....	Broad Creek Mill Pond.....	sunfish (bream).....	300
Washington.....	Hodge's Pond.....	sunfish (bream).....	200
Washington.....	Upper Broad Creek.....	sunfish (bream).....	200
Wise.....	Hick's Pond.....	sunfish (bream).....	200
Highlands.....	Hawkin's Pond.....	yellow perch.....	50
Roseboro.....	Baggett's Pond.....	yellow perch.....	50

FISH PLANTED IN NORTH CAROLINA WATERS BY THE BUREAU OF FISHERIES  
DURING FISCAL YEAR, 1920

Location	Name of Water	Species	Number
Draper.....	Dan River.....	catfish.....	800
Poplar.....	Pigeon Roost Pond.....	catfish.....	140
Marion.....	Upper Broad River.....	catfish.....	800
Pee Dee.....	Blewett Falls Pond.....	catfish.....	600
Tuxedo.....	Green River.....	catfish.....	800
Avoco.....	Albemarle Sound.....	shad.....	*6,560,000
Edenton.....	Albemarle Sound.....	shad.....	*8,035,000
Merry Hill.....	Albemarle Sound.....	shad.....	*1,691,000
Asheville.....	Avery's Creek.....	rainbow trout.....	10,200
Asheville.....	Moore's Creek.....	rainbow trout.....	5,000
Black Mountain.....	Swannanoa River.....	rainbow trout.....	8,800
Blantyre.....	Little Willow Creek.....	rainbow trout.....	6,000
Brevard.....	Buckhorn Creek.....	rainbow trout.....	2,400
Brevard.....	Cascade Lake.....	rainbow trout.....	1,600
Brevard.....	Cedar Rock Creek.....	rainbow trout.....	1,600
Brevard.....	Grogan Creek.....	rainbow trout.....	1,600
Brevard.....	Laurel Creek.....	rainbow trout.....	2,400
Brevard.....	Little River.....	rainbow trout.....	3,200
Clayton.....	Chattooga River.....	rainbow trout.....	3,200
Clyde.....	Bald Creek.....	rainbow trout.....	3,200
Clyde.....	Crabtree Creek.....	rainbow trout.....	4,000
Clyde.....	Liner Creek.....	rainbow trout.....	3,200
Doughton.....	Elkin Creek.....	rainbow trout.....	2,400
Edgemont.....	Anthony's Creek.....	rainbow trout.....	2,500
Elkin.....	Grassy Creek.....	rainbow trout.....	2,400
Elkland.....	Meat Camp Creek.....	rainbow trout.....	2,400
Flat Rock.....	Pullen's Creek.....	rainbow trout.....	1,600
Franklin.....	Nantahala River.....	rainbow trout.....	4,000
Hendersonville.....	Hickory Creek.....	rainbow trout.....	6,000
Hendersonville.....	Morgan's Creek.....	rainbow trout.....	4,000

\*NOTE—Indicates fry, all others are fingerlings.

FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Hendersonville.....	Rocky Broad River.....	rainbow trout.....	7,000
Highlands.....	Cullasaja River.....	rainbow trout.....	3,200
Lake Toxaway.....	Fairfield Lake.....	rainbow trout.....	4,000
Lansing.....	Little Horse Creek.....	rainbow trout.....	2,400
Lenoir.....	Yadkin River.....	rainbow trout.....	2,500
Linville.....	Grassy Creek.....	rainbow trout.....	1,500
Linville.....	Linville River.....	rainbow trout.....	1,500
Linville.....	Lost Cove Creek.....	rainbow trout.....	1,500
Linville.....	Wilson Creek.....	rainbow trout.....	2,000
Montezuma.....	Chestnut Heights Lake.....	rainbow trout.....	500
Montezuma.....	Kentuck Creek.....	rainbow trout.....	1,500
Moore'sville.....	Johnston's Pond.....	rainbow trout.....	1,000
Mortimer.....	Arthur's Creek.....	rainbow trout.....	3,000
Mount Sterling.....	Big Creek.....	rainbow trout.....	3,000
Old Fort.....	Curtis Creek.....	rainbow trout.....	4,000
Pisgah.....	Davidson River.....	rainbow trout.....	45,000
Relief.....	Mills River.....	rainbow trout.....	40,000
Ritter.....	Bone Valley Creek.....	rainbow trout.....	3,200
Ritter.....	Cold Spring Branch.....	rainbow trout.....	2,000
Ritter.....	Hazel Creek.....	rainbow trout.....	3,500
Ritter.....	Proctor Creek.....	rainbow trout.....	2,500
Ritter.....	Sugar Fork Creek.....	rainbow trout.....	2,500
Ritter.....	Walker Creek.....	rainbow trout.....	2,500
Tryon.....	North Pacolet River.....	rainbow trout.....	3,200
Tuxedo.....	Cabin Creek.....	rainbow trout.....	1,600
Tuxedo.....	Green River.....	rainbow trout.....	6,400
Waynesville.....	Brindle's Creek.....	rainbow trout.....	4,000
Waynesville.....	Corns Creek.....	rainbow trout.....	3,200
Waynesville.....	Raccoon Creek.....	rainbow trout.....	3,200
Waynesville.....	Ruben Creek.....	rainbow trout.....	3,200
Willets.....	Scotts Creek.....	rainbow trout.....	2,000
Asheville.....	Little Avery Creek.....	brook trout.....	6,000
Boone.....	New River and branches.....	brook trout.....	15,000
Brevard.....	Carson Creek.....	brook trout.....	3,000
Brevard.....	Gidney Creek.....	brook trout.....	4,500
Brevard.....	Gidney Reese Creek.....	brook trout.....	4,500
Brevard.....	Glady Fork Creek.....	brook trout.....	3,000
Brevard.....	Kennemore Creek.....	brook trout.....	3,000
Brevard.....	Sol Creek.....	brook trout.....	3,000
Brevard.....	Steel's Creek.....	brook trout.....	3,000
Bryson City.....	Deep Creek.....	brook trout.....	3,000
Canton.....	Rhodarmar Creek.....	brook trout.....	3,000
Cherryfield.....	Cherryfield Creek.....	brook trout.....	4,500
Cherryfield.....	Peter Weaver Creek.....	brook trout.....	4,500
Cherryfield.....	Weaver Creek.....	brook trout.....	3,000
Cranberry.....	Cranberry Creek.....	brook trout.....	3,000
Edgemont.....	Laurel Creek.....	brook trout.....	2,000
Elkland.....	Meat Camp Creek.....	brook trout.....	2,400
Elk Park.....	Little Elk Creek.....	brook trout.....	3,000
Highlands.....	Ammon's Branch.....	brook trout.....	3,000
Highlands.....	Big Creek.....	brook trout.....	4,500
Highlands.....	Clear Creek.....	brook trout.....	3,000
Highlands.....	Dog Branch.....	brook trout.....	3,000
Highlands.....	Mill Creek.....	brook trout.....	3,000
Highlands.....	Salt Neck Branch.....	brook trout.....	3,000
Highlands.....	Satulah Creek.....	brook trout.....	3,000
Highlands.....	Silver Creek.....	brook trout.....	3,000
Highlands.....	Turtle Pond Creek.....	brook trout.....	4,500
Lake Toxaway.....	Alexander Creek.....	brook trout.....	2,000



FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Lake Toxaway.....	Bear Pen Lake.....	brook trout.....	3,000
Lake Toxaway.....	Chattooga River.....	brook trout.....	3,000
Lake Toxaway.....	Flat Creek.....	brook trout.....	2,000
Lake Toxaway.....	Green's Creek.....	brook trout.....	2,000
Lake Toxaway.....	James Creek.....	brook trout.....	2,000
Lake Toxaway.....	Lake Sapphire.....	brook trout.....	4,000
Lake Toxaway.....	Little Creek.....	brook trout.....	2,000
Lake Toxaway.....	Mountain View Creek.....	brook trout.....	3,000
Lake Toxaway.....	Panther Tail Creek.....	brook trout.....	3,000
Lake Toxaway.....	Robinson Creek.....	brook trout.....	3,000
Lake Toxaway.....	Slicker Creek.....	brook trout.....	2,000
Lake Toxaway.....	Tennessee Creek.....	brook trout.....	3,000
Lake Toxaway.....	Thompson River.....	brook trout.....	3,000
Lake Toxaway.....	Toxaway Creek, South Fork.....	brook trout.....	2,000
Lake Toxaway.....	Wolf Creek.....	brook trout.....	3,000
Lansing.....	Little Horse Creek.....	brook trout.....	2,400
Montezuma.....	Blue Ridge Lake.....	brook trout.....	10,000
Montezuma.....	Kentuek Creek.....	brook trout.....	3,000
North Wilkesboro.....	Pine Creek Pond.....	brook trout.....	800
Penrose.....	Grassy Creek.....	brook trout.....	6,000
Pisgah Forest.....	Lamb's Creek.....	brook trout.....	4,500
Pisgah Forest.....	Looking Glass Creek.....	brook trout.....	30,000
Pisgah Forest.....	Big Creek.....	brook trout.....	3,000
Rosman.....	French Broad River and branches.....	brook trout.....	15,000
Rosman.....	Shoal Creek.....	brook trout.....	9,000
Rosman.....	Toxaway Creek and branches.....	brook trout.....	9,000
Tuxedo.....	Cabin Creek.....	brook trout.....	3,000
Tuxedo.....	Green River, branch of.....	brook trout.....	4,500
Tuxedo.....	Joe Creek.....	brook trout.....	3,000
Waynesville.....	Pigeon River.....	brook trout.....	9,000
Waynesville.....	Richland Creek.....	brook trout.....	7,500
Waynesville.....	Stevens Creek.....	brook trout.....	3,000
West Jefferson.....	Ezra Fork Creek.....	brook trout.....	2,500
Burlington.....	Haw Creek Pond.....	crappie.....	100
Burlington.....	Little Alamance Pond.....	crappie.....	100
Concord.....	Coddle Creek.....	crappie.....	100
Elizabethtown.....	White Lake.....	crappie.....	50
Franklinton.....	Wilder's Pond.....	crappie.....	50
Havelock.....	East Creek.....	crappie.....	100
Lilesville.....	Juno Pond.....	crappie.....	50
Marshville.....	Brick Yard Pond.....	crappie.....	100
Raleigh.....	Boone's Pond.....	crappie.....	200
Raleigh.....	Doctor's Lake.....	crappie.....	150
Raleigh.....	Edward's Pond.....	crappie.....	100
Raleigh.....	Hayward's Pond.....	crappie.....	100
Raleigh.....	Neuseoco Club Lake.....	crappie.....	300
Raleigh.....	Yates Pond.....	crappie.....	100
Asheville.....	Robertson's Pond.....	largemouth black bass..	*2,000
Asheville.....	Lee Pond.....	largemouth black bass..	200
Asheville.....	Lake Chetola.....	largemouth black bass..	*5,000
Asheville.....	Lane Creek.....	largemouth black bass..	4,000
Asheville.....	Stony Creek Pond.....	largemouth black bass..	4,000
Asheville.....	West View Pond.....	largemouth black bass..	2,000
Clayton.....	Barnes Mill Pond.....	largemouth black bass..	500
Fayetteville.....	Stiltery Creek.....	largemouth black bass..	950
Flat Rock.....	Highland Lake.....	largemouth black bass..	100
Fletchers.....	Mills River.....	largemouth black bass..	100

\*NOTE—Indicates fry, all others are fingerlings.

FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Fountain.....	Checoah Lake.....	largemouth black bass..	100
Franklinton.....	Barrett's Pond.....	largemouth black bass..	150
Gastonia.....	Mountain View Lake.....	largemouth black bass..	375
Greensboro.....	Revolution Pond.....	largemouth black bass..	3,000
Lumber Bridge.....	Shaw's Pond.....	largemouth black bass..	850
Monroe.....	Cox's Pond.....	largemouth black bass..	150
Morrisville.....	Sorrell's Pond.....	largemouth black bass..	570
Montezuma.....	Big Wilson Creek.....	largemouth black bass..	*3,000
New Bern.....	Batchelor Creek.....	largemouth black bass..	180
New Bern.....	Brice's Creek.....	largemouth black bass..	500
New Bern.....	Broad Creek.....	largemouth black bass..	500
New Bern.....	Slocumb's Creek.....	largemouth black bass..	500
New Bern.....	Swift Creek.....	largemouth black bass..	300
New Bern.....	Trent River.....	largemouth black bass..	500
Newland.....	Mill Timber Creek.....	largemouth black bass..	*2,000
Newland.....	Toe River.....	largemouth black bass..	*4,000
Norlina.....	Fishing Creek Pond.....	largemouth black bass..	1,200
Norlina.....	Hawkin's Pond.....	largemouth black bass..	300
Norlina.....	Hawtree Pond.....	largemouth black bass..	300
Norlina.....	Largo Pond.....	largemouth black bass..	800
Norlina.....	Tharrington's Pond.....	largemouth black bass..	400
Norlina.....	Weldon Pond.....	largemouth black bass..	800
Oriental.....	Green's Creek.....	largemouth black bass..	180
Oriental.....	Kershaw Creek.....	largemouth black bass..	500
Oriental.....	Smith's Creek.....	largemouth black bass..	180
Parkton.....	Aurora Pond.....	largemouth black bass..	1,050
Pine Level.....	Overbee and Daugherty Pond.....	largemouth black bass..	500
Raleigh.....	Holleman's Pond.....	largemouth black bass..	150
Raleigh.....	Neuseoco Club Lake.....	largemouth black bass..	2,300
Richfield.....	Arey's Pond.....	largemouth black bass..	100
Rocky Mount.....	Stony Creek.....	largemouth black bass..	500
Roper.....	Blount's Mill Pond.....	largemouth black bass..	500
Statesville.....	Davis Pond.....	largemouth black bass..	1,100
Statesville.....	Morrisons Pond.....	largemouth black bass..	1,100
Statesville.....	Templeton's Pond.....	largemouth black bass..	710
Statesville.....	Vaughns Pond.....	largemouth black bass..	1,100
Warsaw.....	Cooper Mill Pond.....	largemouth black bass..	500
Washington.....	Kennedy's Creek.....	largemouth black bass..	750
Washington.....	Runyon's Creek.....	largemouth black bass..	750
Whiteville.....	Schulken's Mill Pond.....	largemouth black bass..	225
Burlington.....	Back Creek Pond.....	smallmouth black bass..	750
Burlington.....	Wilson Pond.....	smallmouth black bass..	1,050
Flat Rock.....	Mitchell's Pond.....	smallmouth black bass..	100
Lenoir.....	Mulberry Creek.....	smallmouth black bass..	1,750
Parkton.....	Power Plant Pond.....	smallmouth black bass..	800
Raleigh.....	Boone's Pond.....	smallmouth black bass..	100
Sylvia.....	Savannah Creek.....	smallmouth black bass..	1,100
Tryon.....	North Pacolet River.....	smallmouth black bass..	900
Tryon.....	Walnut Creek.....	smallmouth black bass..	900
Asheville.....	Barber's Pond.....	rock bass.....	600
Concord.....	Hathcock's Pond.....	rock bass.....	1,115
Hendersonville.....	Penny's Pond.....	rock bass.....	600
Raleigh.....	Boone's Pond.....	rock bass.....	3,100
Raleigh.....	Cape Fear River Pond.....	rock bass.....	1,200
Raleigh.....	Honeycutt Pond.....	rock bass.....	2,500
Raleigh.....	Neuse River Pond.....	rock bass.....	1,200
Salisbury.....	Kemmerley's Pond.....	rock bass.....	1,000

\*NOTE—Indicates fry, all others are fingerlings.



FISH PLANTED IN NORTH CAROLINA WATERS—*Continued*

Location	Name of Water	Species	Number
Aberdeen.....	Mill Creek.....	sunfish.....	400
Auburn.....	Ferrill's Pond.....	sunfish.....	250
Badin.....	Narrows Lake.....	sunfish.....	3,000
Benson.....	Dick's Branch.....	sunfish.....	1,000
Burlington.....	Little Alamance Pond.....	sunfish.....	300
Burlington.....	Pickard's Pond.....	sunfish.....	300
Charlotte.....	Lakewood Park Lake.....	sunfish.....	1,000
Clayton.....	White Oak Pond.....	sunfish.....	500
Clinton.....	Shady Brook.....	sunfish.....	200
Crouse.....	McGinnis Pond.....	sunfish.....	1,000
Dillard.....	Chenond's Ponds.....	sunfish.....	200
Four Oaks.....	Blackwater Pond.....	sunfish.....	1,000
Gastonia.....	Armstrong's Pond.....	sunfish.....	400
Gastonia.....	Gaston Club Lake.....	sunfish.....	600
Goldsboro.....	Stephens Mill Pond.....	sunfish.....	600
Gold Hill.....	Trexler's Pond.....	sunfish.....	200
Greensboro.....	Boone's Pond.....	sunfish.....	600
Greensboro.....	Lake Summit.....	sunfish.....	250
Greensboro.....	North Buffalo Pond.....	sunfish.....	600
Guilford.....	Jackson's Pond.....	sunfish.....	400
Henderson.....	Faulkner Ponds.....	sunfish.....	200
Henderson.....	Northside Pond.....	sunfish.....	200
Henderson.....	Parker's Pond.....	sunfish.....	200
High Point.....	Briles Pond.....	sunfish.....	250
High Point.....	Nickelson Spring Pond.....	sunfish.....	250
Holly Springs.....	Basil Creek Pond.....	sunfish.....	500
Keyser.....	Addor's Pond.....	sunfish.....	400
Kinston.....	Kennedy's Mill Pond.....	sunfish.....	200
Lake Junaluska.....	Lake Junaluska.....	sunfish.....	1,000
Lake Junaluska.....	Lake Utah.....	sunfish.....	1,000
Liberty.....	Durham Mill Pond.....	sunfish.....	200
Liberty.....	Fox Pond.....	sunfish.....	250
Marshville.....	Stegall's Pond.....	sunfish.....	200
Monroe.....	Fulenwider's Pond.....	sunfish.....	200
Mount Airy.....	Lovers Creek.....	sunfish.....	100
Norlina.....	Sandy Creek Pond.....	sunfish.....	200
North Wilkesboro.....	Jenkins Pond.....	sunfish.....	200
Raleigh.....	Bain's Pond.....	sunfish.....	200
Raleigh.....	Boone's Pond.....	sunfish.....	4,425
Raleigh.....	Cape Fear River Pond.....	sunfish.....	1,800
Raleigh.....	Davis Pond.....	sunfish.....	250
Raleigh.....	Doctors Lake.....	sunfish.....	250
Raleigh.....	Drum Pond.....	sunfish.....	225
Raleigh.....	Honeycutt Pond.....	sunfish.....	3,250
Raleigh.....	Hoods Mill Pond.....	sunfish.....	250
Raleigh.....	Neuse River Pond.....	sunfish.....	2,000
Raleigh.....	Yates' Pond.....	sunfish.....	250
Smithfield.....	Holt's Lake.....	sunfish.....	700
Washington.....	Broad Creek.....	sunfish.....	400
Washington.....	Chocowinty Bay.....	sunfish.....	200
Washington.....	Chocowinty Creek.....	sunfish.....	200
Washington.....	Respass Mill Pond.....	sunfish.....	200
Raleigh.....	Neusecoo Club Lake.....	yellow perch.....	350
Weldon.....	Roanoke River.....	striped bass.....	*1,647,000

NOTE—\*Indicates fry, all others are fingerlings.

## MAPPING DIVISION

Under this head is included the preparation of the various maps of the State and counties, and can be summarized as follows:

1. Base Map
2. Topographic Map
3. Traverse Map
4. Soil Map
5. Geological Map

1. *Base Map*.—A base map of the State, on a scale of 1:500,000, was prepared several years ago by the Survey in coöperation with the U. S. Geological Survey and is used for preparing special maps, such as maps showing transmission lines of power companies; railroad lines; forest areas; etc. These maps have been furnished to many of the various State departments.

A new edition of this map is being prepared by the Survey which will show the National Forests established in the State and the more important drainage canals in Eastern North Carolina, in addition to the corrections and additions relating to roads, towns, county lines, etc.

2. *Topographic Map*.—The most valuable map to the State would be a complete topographic map of the whole area, such as is being prepared by the U. S. Geological Survey. The need of an accurate topographic map has increased many fold during the past decade, due to the extensive construction of highways, water power developments, and geological and mining investigations. It is undoubtedly the intention of the Federal Government to complete a topographic map of the United States as rapidly as possible, but with the present appropriation it will take at least twenty years before this can be completed unless there is more coöperation between the States and the Federal Government. Several of the States have complete topographic maps of their area, but this has been accomplished by the States paying a considerable proportion of the cost of making the map. At the present time about 36 per cent of the area of North Carolina has been completed, and it is estimated that it will cost \$1,244,000 to complete a topographic map of the State. Such a map would be of inestimable value to the State Highway Commission in its highway work; to the Survey in its geological work and mapping of the geological areas of the State; to the Agricultural Department in the preparation of the soil maps of the State; to the Survey and power companies in water power investigations; and to railroad corporations in their location work. All this topographic mapping should be done by the Federal



Survey, as they have the complete organization for this type of work and can do it cheaper and more efficiently than for a State to try to develop its own organization. If the State would coöperate and make an appropriation for topographic work, we would get a much larger appropriation from the Federal Survey for this work.

The need of this map is constantly increasing, and the Board of Surveys and Maps of the Federal Government is making every endeavor possible to bring about the completion of such a map of the whole country as early as possible. The States that coöperate will be the first to be mapped, and in a recent communication from the Chairman of the Board, he states:

"I am advised by the Geological Survey that the least workable appropriation which should be asked for is \$5,000, for the reason that, on a dollar for dollar basis, such an appropriation, matched by an equal amount from the government will serve to survey one regular quadrangle; and further, that probably they would not be able to use annually more than \$25,000, in view of the fact that it is anticipated a large number of States will secure appropriations this year."

The Director has taken up with the Highway Commissioner the question of the Highway Commission coöperating with the Survey in asking the legislature to appropriate a sufficient amount to enable the State to coöperate with the Federal Government to the amount of \$25,000 per year. It is believed that such a bill should be introduced and should be supported by the State Highway Commission, the Department of Agriculture and the Survey.

During the past six months topographic maps have been made of areas in Cherokee and Ashe Counties which were required for the preparation of geological maps of the iron ores of the State. This work was done under the supervision of Prof. T. F. Hickerson of the University.

3. *Traverse Map.*—There is a continual demand for traverse maps of the various counties, and the Director is trying to arrange with the Federal Survey to assist the counties in the preparation of accurate traverse maps of the several counties of the State. The traverse map would not show the topography unless the Federal Survey has already topographically mapped the area covered by the county, but would show the township lines, county lines, railways, streams, swamp areas (if any), cities and towns, and all houses in country. These maps are somewhat expensive, as all its roads and streams are actually traversed. It is hard to make our county commissioners realize that an accurate map of their county cannot be prepared at a low figure. We have had several instances where we have prepared plans

for the county for the preparation of a traverse map or topographic map of the county, where the county commissioners have turned down the Survey's proposition, stating that they can have an accurate map made of the county at a cost of one-half or two-thirds less than what the Survey is asking. When it is realized that the Survey is only asking the county to pay 50 per cent of the actual cost of the preparation of the map, as it would be made by the Survey, it can be readily seen that it would be absolutely impossible for anyone to make an accurate map of the county at a cost of one-half to two-thirds less than this.

4. *Soil Map*.—These maps are all prepared by the Department of Agriculture, but they use, whenever possible, the base or topographic map of the county which has been prepared by the Survey.

5. *Geological Map*.—The Survey is preparing a new geological map of the State. No complete map of this type of the State has been prepared since the publication of the geological map by former State Geologist, W. C. Kerr, in 1882. Special geological maps have, however, been published of separate portions of the State, as the Coastal Plain region, Mountain region, and certain sections of the Piedmont area. Some progress was made on the geological map by the work of Prof. W. S. Bayley, Mr. Jasper L. Stuckey and Mr. Thos. Smith during the field season of 1920.

#### ADMINISTRATIVE AND RECORDS DIVISION

The work of this division has been under the direct supervision of the Director of the Survey and includes the general correspondence of the Survey, handling of accounts, editing and preparing for the publisher of manuscripts of reports, press notices, etc., the general clerical work, care of library, arranging for coöperative work with Federal and State bureaus, associations, etc.

#### Suggested Legislation

The following suggested legislation is submitted, with the approval of the Geological Board, for the expansion of the work of the Survey so as to make it a real conservation commission:

#### CONSERVATION COMMISSION AND GEOLOGICAL SURVEY

A BILL TO BE ENTITLED "AN ACT TO ESTABLISH THE NORTH CAROLINA CONSERVATION COMMISSION AND GEOLOGICAL SURVEY."

*The General Assembly of North Carolina do enact:*

SECTION 1. There is herewith established a department to be known as the North Carolina Conservation Commission and Geological Survey, which shall exercise and perform all the rights, powers, duties and obligations that have been heretofore exercised and performed by the Geological



and Economic Survey, and Geological Board, the Mount Mitchell State Park Commission, the State Geologist and the State Forester, and shall be the lawful successor of said Survey, Board, Commission, and office, and upon the passage of this section those portions of the acts establishing the North Carolina Geological and Economic Survey, the Geological Board, and the Mount Mitchell State Park Commission, and that portion of the act relating to the appointment of the State Geologist, are herewith repealed.

SEC. 2. The North Carolina Conservation Commission and Geological Survey shall be under the supervision of a Conservation Board which shall consist of five members, four of which shall be the members now constituting the Geological Board, and one member to be appointed by the Governor from the present Mount Mitchell State Park Commission; and shall hold office until the expiration of the term of years for which they are now appointed on the Geological Board and the Mount Mitchell State Park Commission. Thereafter members will be appointed by the Governor for the period of four years and until their successors have been appointed. The Governor shall fill by appointment any vacancies that may occur on the Conservation Board for the unexpired term. This Board shall meet twice a year at such times and places as the Board may decide. The members of the Board shall receive ten dollars per diem and their actual expenses in attending the meetings of said Board, such sums to be paid out of the moneys appropriated for carrying on the work of the Commission.

SEC. 3. The Conservation Board shall appoint a Director, who shall be the executive and administrative head of the Commission, and shall organize the Commission in divisions, to include, among others, a geological and mining division, a forestry division, a water resources division, a drainage and reclamation division, a State forests and parks division, fish, game and bird division, museum of natural resources division, and a mapping division; and shall supervise same by and with the approval of the Conservation Board. He shall have charge of the administration and enforcement of all laws which it is the duty of the Commission to administer and enforce, and shall direct all inspections and investigations. He shall employ such chiefs of divisions, assistants and clerical help as may be considered necessary to carry on the work of the Commission, by and with the approval of the Conservation Board. The compensation of employees of the Commission shall be determined by the Conservation Board.

SEC. 4. The chief of the geological and mining division shall be known as the State Geologist, and the chief of the forestry division shall be known as the State Forester. All acts that shall be passed by the General Assembly relating to the investigation, conservation, development and supervision of the natural resources of the State on the part of the State shall be referred to and be carried out under the direction of the Conservation Commission; this does not apply to the commercial fisheries which are under the jurisdiction of the Fisheries Commission, nor to agricultural lands and products which are under the supervision of the Agricultural Department.

SEC. 5. The Conservation Commission may purchase and hold additional lands within the State for the production of timber and for State parks, with such moneys as may be appropriated by the General Assembly or as may be otherwise obtained. The Commission is also authorized to accept gifts of lands within the State for such purposes. The Conservation Commission may, in its discretion, make rules and regulations relative to hunting

and fishing or other uses of any lands acquired under the provisions of this act; *Provided*, that such rules and regulations shall be subject to any restrictions imposed by laws now or hereafter in force for the protection of fish, birds, and quadrupeds.

SEC. 6. The Conservation Commission is herewith authorized to coöperate with the Bureau of Fisheries of the United States, the United States Biological Survey, the North Carolina Fisheries Commission, and other similar public and private surveys and associations in the propagation, protection and conservation of the song and game birds, game fish, and game of the State. The Conservation Commission is also authorized to coöperate with the North Carolina Audubon Society and other protective associations interested in the preservation of animal life.

SEC. 7. The Conservation Board is hereby authorized and directed to coöperate with the Federal Power Commission in the carrying out of rules and regulations promulgated by that Commission; and is further authorized to act on behalf of the State in carrying out any regulations that may be passed relating to water powers in North Carolina.

SEC. 8. All laws and clauses of laws in conflict with this act are hereby repealed.

SEC. 9. This act shall be in effect from and after its ratification.

The Director has had several conferences with Dr. George Otis Smith, Director of the United States Geological Survey, and Mr. N. C. Grover, Chief of the Division of Water Resources, in regard to establishing a district engineer's office at Asheville which would be used also by the State Survey as a branch office. It was also considered that it would be to the advantage of both Surveys to have such a joint office at Asheville, at which could be illustrated and advertised the resources of the Southern Appalachian region.

On September 27, 1920, the following letter was received from Dr. George Otis Smith, Director of the U. S. Geological Survey:

COLONEL JOSEPH HYDE PRATT, *Director*,  
*North Carolina Geological and Economic Survey*,  
*Chapel Hill, N. C.*

MY DEAR COLONEL PRATT:—In furtherance of the coöperation between the U. S. Geological Survey and the North Carolina Geological and Economic Survey in the study of the water resources of North Carolina, a district office will be established at Asheville, N. C., in accordance with the arrangements made with you orally by Messrs. Grover and Hoyt. Mr. Warren E. Hall will be assigned in charge of the office, and the U. S. Geological Survey will rent the necessary office space. The other details of work and assignments may be arranged directly between you and Mr. Grover.

Yours very truly,

(Signed) GEORGE OTIS SMITH, *Director*.

In accordance with this letter the Director of the State Survey had several conferences with Mr. N. C. Grover, Chief of the Water Resources Division of the U. S. Geological Survey, and a satisfactory



agreement was reached in regard to the Asheville office. Arrangements were made with the Asheville Board of Trade by which nearly one-half of the space occupied by this Board of Trade in the Asheville Club Building was leased to the U. S. Geological Survey for the District Engineer's office. This office will be in the charge of Mr. Warren E. Hall, Hydraulic Engineer of the Federal Survey, who will have associated with him an assistant engineer. A clerk will also be kept in attendance at this office at all times to give information in regard to the resources of the Southern Appalachian region and to answer inquiries of those who visit the exhibit room. Sample copies of the publications of both the Federal and State Surveys will be on exhibition in this room.

The State Survey is very badly cramped for quarters and, with the contemplated expansion of its work, it will be necessary that larger quarters be obtained. Perhaps the most practical plan is for the State to appropriate sufficient funds with which to erect a building at the University which will accommodate the Geological and Geography Departments of the University and the Geological Survey. This has been done very advantageously at a number of State Universities, and it is suggested that the General Assembly make an appropriation of \$250,000 for the construction of such a building. This plan is agreeable and considered satisfactory both to the University and the Survey.

#### Publications

During the past two years the following publications have been issued by the Survey:

##### VOLUMES

Volume IV—The Birds of North Carolina.

##### ECONOMIC PAPERS

- 49—The Mining Industry in North Carolina during 1913-1917, Inclusive.
- 50—Proceedings of the Tenth Annual Drainage Convention, held at Washington, North Carolina, March 31 and April 1, 1920.

##### PRESS BULLETINS

- 168—Timber Resources of Union County.
- 169—Timber Resources of Moore County.
- 170—The Mining Industry in North Carolina during 1918.
- 171—Our Future Hardwood Supply.
- 172—The Relation of Water Resources to Forestry.
- 173—A Minimum Forest Policy for the Southern Appalachians.
- 174—Forest Taxation.
- 175—The Water Powers of North Carolina.

## PRESS NOTICES

Press Notices Nos. 149 to 185 have been issued. The Press Bulletins are short printed articles, while the Press Notices are briefer articles prepared on the multigraph and distributed to State papers, commercial organizations and individuals interested in the work of the Survey.

In addition to these Survey publications, special articles and reports have been prepared by the several members of the Survey staff, as follows:

JOSEPH HYDE PRATT, *Director*: Hard Surfaced Roads, *Manufacturers' Record*, July 22, 1920.

Forest Protecting Laws a Necessity, *The Music Trades*, New York. August 14, 1920.

Successful Reclamation of Swamp and Overflowed Lands in North Carolina, for the annual meeting of the National Drainage Congress, Atlanta, Nov. 10, 1920.

Report on the Work of the North Carolina Geological Survey and Mining Conditions in North Carolina, for the annual meeting American Mining Congress, Denver, Colo., Nov. 15, 1920.

Iron Mining in North Carolina, for the *Engineering and Mining Journal*, Nov. 20, 1920.

A study of the Organization and Activities of the Various Scientific and Research Departments and Divisions of the State of North Carolina, for the National Research Council, Nov. 20, 1920.

THORNDIKE SAVILLE, *Hydraulic Engineer*: The Relation of Flood Control to Drainage. (Address delivered before meeting of N. C. Drainage Association, Washington, N. C., April 1, 1920. Reprinted by the Survey.

The Relation of Water Resources to Forestry. (Printed as Press Bulletin 172 to the Survey's Publications.)

The Water Power Situation in North Carolina. (Printed as Press Bulletin 175 of the Survey's publications.)

T. F. HICKERSON, *Civil Engineer*: Present Status of Road Building in the United State, *University of North Carolina News Letter*, February, 1920.

Relation of the Engineer to Successful Road Location, Construction and Maintenance, *University of South Carolina Road Institute*, March 3-4, 1920; *Good Roads Magazine*, May, 1920; *Southern Good Roads*, June, 1920.

Road Alignment Problems, Talk at meeting of the Engineers' Society of Western North Carolina, Asheville, N. C., April, 1920.

A New Method of Locating Curves for Roads and Streets, *Engineering and Contracting*, June 2, 1920; *Journal Elisha Mitchell Scientific Society*, August, 1920; *Public Roads*, October, 1920; (Complete set of tables published by the author, July, 1920.)

WM. F. PROUTY, *Geologist*: Review Graphite Industry in Alabama for 1919, *Engineering and Mining Journal*, Jan., 1920.

The Geology of Clay County, Alabama, *Journal Elisha Mitchell Scientific Society*.

Age of the Hillsbee Schists of Clay County, Alabama.

A More Remarkable Shoot, *Journal Elisha Mitchell Scientific Society*.

Geological Map of Clay County, Alabama, for the Alabama Geological Survey.



W. C. COKER, *Botanist*: The Hydums of North Carolina. *Journal E. M. Sci. Soc.* 34: 163. 29 plates (two in color.) 1919.

The Distribution of *Rhododendron Catawbiense*, with Remarks on a new Form. *Journ. E. M. Sci. Soc.* 35: 76. 4 plates. 1919.

Craterellus, Cantharellus and Related Genera in North Carolina: with a Key to the Genera of Gill Fungi. *Journ. E. M. Sci. Soc.* 35: 24. 17 plates (one in color.) 1919.

Notes on the Lower Basidiomycetes of North Carolina. *Journ. E. M. Sci. Soc.* 36: 97. 2 plates (one in color.) 1920.

Azalea Atlantica Ashe and its Variety luteo-alba n. var. *Journ. E. M. Sci. Soc.* 36: 97. 2 plates (one in color.) 1920.

A New Species of Achlya (with J. N. Couch.) *Journ. E. M. Sci. Soc.* 36: 100. 1920.

Genera of Lower Basidiomycetes not Before Reported from North America. Paper presented before the 19th meeting of the North Carolina Academy of Science. Abstract in *Journ. E. M. Sci. Soc.* 36: 14. 1920.

Saprolegniaceae of the United States. A volume now in press.

Notes on the Thelephoraceae of the United States. *Journ. E. M. Sci. Soc.* 36.

*Addresses.*—The members of the Survey staff have been frequently called upon to make addresses at meetings within and without the State on subjects relating to phases of the natural resources of the State. Whenever it has been possible these requests have been granted, and during this biennial period the following addresses have been made:

JOSEPH HYDE PRATT, *Director*: Hard Surfaced Roads in France, given before Annual Convention of the North Carolina Good Roads Association, Wrightsville Beach, N. C., August, 1919.

Forests and Highways of Western North Carolina, before good roads meeting at Sparta, N. C., Sept. 1, 1919.

What We Can Learn from French Forestry, given before meeting of Forestry Association in Asheville, June 9, 1920.

Hard Surfaced Roads, given at Annual Convention North Carolina Good Roads Association, Asheville, June 16, 1920.

Good Roads, given before meeting of Retail Merchants' Association, Asheville, June 17, 1920.

Forestry Legislation, given before committee of Society of American Foresters, Washington, D. C., September 8, 1920.

Value of the R. O. T. C. to the University, given before student body, University of North Carolina, Chapel Hill, October 8, 1920.

J. S. HOLMES, *State Forester*: Informal talks before a number of schools in Edgecombe County, in April, 1919, on Forest Fires, Tree Life, Arbor Day, Roadside and Memorial Trees, etc.

North Carolina Forests—Their Use and Care, illustrated lecture before Lindsey Street School, Greensboro, May 8, 1919.

Lectures on Forestry before a number of summer school and teachers' institutes in July, 1919, and August, 1919.

The Need for a Forest Experiment Station in the Southern Appalachians, given at a meeting of the Board of Trade, Asheville, December, 1919.

Forest Fire Prevention, given before student body, University of North Carolina, Chapel Hill, January, 1920.

The Forestry Outlook in the Southern Appalachian Region, given before the Southern Forestry Congress, New Orleans, La., January, 1920.

Our Future Hardwood Supply, to have been given before Southern Furniture Manufacturers' Association, Charlotte, February, 1920. (Prepared but not delivered on account of postponement.)

Forest Fire Prevention, given before Railroad conference, Raleigh, April, 1920.

A Minimum Forest Policy for the Southern Appalachians, given before the Appalachian Logging Congress, Asheville, June, 1920.

Forest Fire Prevention, given before Tryon Forestry Club, Tryon, November, 1920.

Forests of North Carolina and Arbor Day, given before the students of the High School, China Grove, November, 1920.

A Forest Experiment Station for Western North Carolina, given before the Elisha Mitchell Scientific Society, Chapel Hill, November, 1920.

Forestry Associations and Fire Prevention, given at the Collaborators' Conference, Washington, D. C., November, 1920.

North Carolina's Forestry Problems, given before the North Carolina Pine Association, Norfolk, Va., November, 1920.

The Meaning of Arbor Day in North Carolina, an address before the High School, Durham, November, 1920.

THORNDIKE SAVILLE, *Hydraulic Engineer*: The Relation of Flood Control to Drainage, North Carolina Drainage Association, Washington, N. C., April 1, 1920.

The Relation of Water Resources to Forestry, given before the North Carolina Forestry Association, Asheville, June 9, 1920.

Coöperation by North Carolina Geological and Economic Survey with Counties in Making Water Power Surveys, given before the following meetings: Lenoir Chamber of Commerce, June 8, 1920; County Commissioners of Surry County, August 2, 1920; State County Commissioners' Association, Greensboro, August 11, 1920; North Wilkesboro Commercial Club, August 20, 1920.

The Water Power Situation in North Carolina, given before the State Chamber of Commerce, Wrightsville Beach, July 21, 1920.

There is now ready for publication Part I, Volume V, on "The Cretaceous Formations of North Carolina"; Volume VI, on "Mushrooms of North Carolina"; and Bulletin 28 on "The Limestones and Marls of North Carolina."

There is in the hands of the Public Printer a report on the Virginina copper deposits, which was prepared jointly by the North Carolina Geological Survey and the Virginia Geological Survey. The Virginia Survey has had its report published for over three years.

According to the Commissioner of Labor and Printing, the delay in publishing the reports of the Geological Survey is due to lack of funds



for printing. These reports have been prepared in accordance with instructions of the General Assembly relative to the work of the Geological Survey.

In order that the results of investigations made by the Survey may be made available to the people of the State and to others interested in this State's natural resources, it is suggested that the printing of the reports of the Survey be referred to the Printing Commission as to what shall be published and the size of the edition; and whether the cost of the publication shall be charged against any special printing fund assigned to the Geological Survey or charged against the general treasury.

#### Exhibits

The Survey has, as usual, made exhibits at the State Fairs held in Raleigh October 20-25, 1919; and October 18-23, 1920. The exhibits consisted of elaborate displays of mineral and forestry products. At the 1920 Fair the U. S. Forest Service coöperated with the State Survey in the forestry exhibit.

It is believed that the State Fair could be made much more profitable in advertising the State's resources if the midway attractions were eliminated. The Director has attended State Fairs in other States where these States have appropriated as much as \$100,000 annually for their support. There were no midway attractions at these fairs such as are seen at the North Carolina State Fair, and yet there were proportionately as many people, if not more, in attendance as at our fair; the exhibits representing the State's resources were infinitely greater and better than ours; and the people who attended were there to look at them and study them.

At the request of the State Department of Agriculture and the Asheville Board of Trade the greater part of the forestry exhibit was displayed at the Western North Carolina Apple Show in Asheville, October 27-29. From the point of view of the attention which the exhibit attracted, this was much more successful than the exhibit at the State Fair, the reason being the character and attitude of mind of the people attending. The apple show was free and no distracting side shows were present. It is planned to hold this apple show annually, and it is felt that the Survey should again be represented, with an even more attractive exhibit.

At the request of the Women's Club at Oxford a small exhibit of forestry posters, photographs and publications was made at the Granville County Fair, October 5, 6 and 7. Mr. B. W. Sipe, of the Survey, spent a day at Oxford explaining the exhibit, distributing Survey pub-

lications, etc., to the people in attendance. It is felt that this effort was well worth while.

*Window Exhibits.*—At the Asheville office it is proposed to have attractive exhibits arranged for the large window which faces the street and is on the ground floor. In this exhibit the resources of the Southern Appalachian region will be shown. It is also suggested that similar exhibits of the State's resources and forestry problems can be illustrated to advantage by making similar window exhibits in coöperation with some of the larger stores in our larger cities. This has been done to advantage in other States, and it is believed that the Survey can use this method of advertising the State's resources to advantage.

It is believed that the Survey should plan to make a rather elaborate display of what has been accomplished in drainage and what can be produced on the reclaimed lands at the next National Drainage Congress. It is also believed that an exhibition of mineral and water power resources could be made to good advantage at the Chemical Industries Exposition in New York.

#### Financial Statement

There is given below a statement which shows the receipts and expenditures of the North Carolina Geological and Economic Survey for the two years ending November 30, 1920, grouped together according to subjects investigated during this time. The receipts cover moneys received from the State Treasury representing the annual appropriations and the other sums received from individuals or companies for coöperative work of various kinds, as indicated. It also includes a statement of funds received from the sale of timber on Mitchell State Park which were used for the protection and maintenance of the park.

JOSEPH HYDE PRATT,

*Director and State Geologist,*

*North Carolina Geological and Economic Survey.*

DECEMBER 1, 1918, TO NOVEMBER 30, 1919

#### RECEIPTS

Balance on hand .....	\$ 3,439.71
Annual appropriation authorized by Chapter 145, Public Laws of 1919 .....	20,000.00
Amount received for coöperative forest fire patrol.....	123.64
Interest on daily balance in bank.....	98.99
Received from associations for clerical and multigraph work.....	206.78
Received for chemical work.....	3.00



## DISBURSEMENTS

General geological and mineralogical investigations....	\$ 1,209.55	
Coöperative forest fire patrol.....	101.64	
Forestry investigations .....	4,285.52	
Waterpower investigations.....	283.11	
Road investigations .....	592.04	
Drainage investigations .....	115.13	
Administrative expenses .....	5,000.00	
Clerical and editorial expenses.....	2,754.94	
Geological Board expenses .....	110.28	
Office supplies and expenses.....	1,290.02	
Office equipment .....	81.06	
Balance on hand .....	8,048.83	
	\$23,872.12	\$23,872.12

## MOUNT MITCHELL FUND

## RECEIPTS

Balance on hand .....	\$ 578.57
Amount received for timber.....	646.12

## DISBURSEMENTS

Dec. D. L. Moser, salary.....	\$ 90.00	
Feb. D. L. Moser, Salary.....	90.00	
Fred Moser, labor .....	12.00	
Mar. D. L. Moser, salary.....	90.00	
Fred Moser, salary .....	75.00	
Charlie King, labor .....	23.75	
April D. L. Moser, salary.....	90.00	
Fred Moser, salary .....	75.00	
May Fred Moser, salary.....	75.00	
July D. L. Moser, salary.....	90.00	
Aug. D. L. Moser, salary.....	90.00	
Balance on hand.....	423.94	
	\$1,224.69	\$1,224.69

## DECEMBER 1, 1919, TO NOVEMBER 30, 1920

## RECEIPTS

Balance on hand .....	\$ 8,048.83
Annual appropriation authorized by Chapter 145, Public Laws of 1919 .....	20,000.00
Received for coöperative forest fire patrol.....	571.41
Sale of pulpwood on Mount Mitchell State Park.....	31.79
Received from multigraph work.....	91.20
Interest on daily balances.....	283.30
Sale of Mountain Transit.....	175.00
Coöperative waterpower work.....	46.16
Received from J. S. Holmes for postage.....	4.34

## DISBURSEMENTS

General geological and mineralogical investigations...	\$ 3,697.83	
Forestry investigations .....	4,767.07	
Forest fire patrol work.....	1,399.14	
Coöperative forest fire patrol work .....	512.00	
Waterpower investigations .....	6,168.15	
Drainage investigations .....	398.50	
Administrative expenses .....	6,616.67	
Clerical and editorial expenses.....	3,058.75	
Geological Board expenses .....	64.48	
Office supplies and expenses.....	1,807.69	
Office equipment .....	437.65	
Balance on hand.....	324.10	
	<hr/>	
	\$29,252.03	\$29,252.03

## MOUNT MITCHELL FUND

## RECEIPTS

Balance on hand.....	\$423.94
Amount received from timber*.....	31.79

## DISBURSEMENTS

Dec. D. L. Moser, salary .....	\$ 90.00	
W. K. Hall, labor .....	15.00	
Jan. D. L. Moser, salary, one-half month.....	50.00	
Fred Moser, labor .....	18.00	
Feb. Fred Moser, labor .....	33.00	
David Moser, labor .....	22.50	
Mar. Fred Moser, labor .....	39.00	
David Moser, labor .....	67.38	
April Fred Moser, labor .....	79.63	
May David Moser, labor .....	33.00	
Balance on hand .....	8.22	
	<hr/>	
	\$455.73	\$455.73

\* Also carried in general funds of Survey.



PUBLICATIONS  
OF THE  
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

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BULLETINS

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 50 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands, and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Out of print.*
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7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Out of print.*
8. Water powers in North Carolina, by George F. Swain, Joseph A. Holmes, and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Out of print.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Out of print.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesians Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Out of print.*
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15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 10 cents.*
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17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy, and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents. Cloth-bound copy, \$1.00.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglas B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

20. Water powers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*

21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents. Cloth copies 75 cents.*

22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents. Cloth copies 75 cents.*

23. Forest Conditions in Western North Carolina, by J. S. Holmes, 1911. 8°, 116 pp., 8 pl. *Postage 15 cents.*

24. Loblolly or North Carolina Pine, by W. W. Ashe, Forest Inspector, U. S. Forest Service (and former Forester of the North Carolina Geological and Economic Survey). Prepared in Coöperation with the Forest Service, U. S. Department of Agriculture, 1914. 8°, 176 pp., 27 pl., 5 figs. *Postage 15 cents. Cloth copies 75 cents.*

25. Zircon, Monazite, and Other Minerals used in the Production of Chemical Compounds Employed in the Manufacture of Lighting Apparatus, by Joseph Hyde Pratt, Ph. D., 1916. 8°, 120 pp., 3 pl. *Postage 15 cents. Cloth copies 75 cents.*

26. A Report on the Virgilina Copper District of North Carolina and Virginia, by F. B. Laney, Ph.D., 1917. 8°, 176 pp., 20 pl., 16 figs.

27. The Altitudes of North Carolina, 1917. 8°, 124 pp. *Postage 20 cents.*

#### ECONOMIC PAPERS

1. The Maple Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Out of Print.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Out of print.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestone; describes and gives Uses for the various forms of clay; and under the head of "Other Economic Minerals," describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Out of print.*



8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Out of Print.*

Gives description of Mines worked for Gold in 1903; description of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives, Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities; Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Out of print.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Out of Print.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interests in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp. 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Out of print.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper and Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Out of print.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Out of print.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Out of print.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Out of print.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Out of print.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp. 3 pl. *Out of print.*

22. Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Out of print.*

23. Mining Industry in North Carolina During 1908, '09, and '10, by Joseph Hyde Pratt and Miss H. M. Berry, 1911. 8°, 134 pp., 1 pl., 27 figs. *Postage 10 cents. Cloth copies 50 cents extra.*

Gives report on Virgilina Copper District of North Carolina and Virginia, by F. B. Laney; Detailed report on Mica deposits of North Carolina, by Douglas B. Sterrett; Detailed report on Monazite, by Douglas B. Sterrett; Reports on various Gem Minerals, by Douglas B. Sterrett; Information and Analyses concerning certain Mineral Springs; Extracts from Chance Report of the Dan River and Deep River Coal Fields; some notes on the Peat Industry, by Professor Charles A. Davis; Extract from report of Arthur Keith on the Nantahala Marble; Description of the manufacture of Sand-lime Brick.

24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Out of print.*

25. Proceedings of Second Annual Convention of the North Carolina Forestry Association, held at Raleigh, North Carolina, February 21, 1912. Forest Fires in North Carolina During 1911. Suggested Forestry Legislation. Compiled by J. S. Holmes, Forester, 1912. 8°, 71 pp. *Postage 5 cents.*

26. Proceedings of Fourth Annual Drainage Convention, held at Elizabeth City, North Carolina, November 15 and 16, 1911, compiled by Joseph Hyde Pratt, State Geologist, 1912. 8°, 45 pp. *Out of print.*

27. Highway Work in North Carolina, containing a Statistical Report of Road Work during 1911, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1912. 8°, 145, pp. 11 figs. *Out of print.*

28. Culverts and Small Bridges for Country Roads in North Carolina, by C. R. Thomas and T. F. Hickerson, 1912. 8°, 56 pp., 14 figs., 20 pl. *Postage 10 cents.*

29. Report of the Fisheries Convention held at New Bern, N. C., December 13, 1911, compiled by Joseph Hyde Pratt, State Geologist, together with a Compendium of the Stenographic Notes of the Meetings Held on the two trips taken by the Legislative Fish Committee Appointed by the General Assembly of 1909, and the Legislation Recommended by this Committee, 1912. 8°, 302 pp. *Postage 15 cents.*

30. Proceedings of the Annual Convention of the North Carolina Good Roads Association held at Charlotte, N. C., August 1 and 2, 1912, in Coöperation with the North Carolina Geological and Economic Survey. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1912. 8°, 109 pp. *Postage 10 cents.*



31. Proceedings of Fifth Annual Drainage Convention held at Raleigh, N. C., November 26 and 27, 1912. Compiled by Joseph Hyde Pratt, State Geologist. 8°, 56 pp., 6 pl. *Postage 5 cents.*

32. Public Roads are Public Necessities, by Joseph Hyde Pratt, State Geologist, 1913. 8°, 62 pp. *Postage 5 cents.*

33. Forest Fires in North Carolina during 1912 and National and Association Coöperative Fire Control, by J. S. Holmes, Forester, 1913. 8°, 63 pp. *Postage 5 cents.*

34. Mining Industry in North Carolina during 1911-12, by Joseph Hyde Pratt, State Geologist, 1914. 8°, 314 pp., 23 pl., 12 figs. *Postage 15 cents.*

Gives detailed report on Gold Mining in various counties with special report on Metallurgical Processes used at the Iola Mine, by Claud Hafer; description of a Cyanide Mill, by Percy Barbour; the new milling process for treating North Carolina Siliceous Gold Ores at the Montgomery Mine, including a description of the Uwarrie Mining Company's Plant; notes on the Carter Mine, Montgomery County, by Claud Hafer; also a description of the Howie Mine and its mill; a detailed report of the Coggins (Appalachian) Gold Mine, by Joseph Hyde Pratt; a list of gems and gem minerals occurring in the United States; special descriptions of Localities where the Amethyst, Beryl, Emerald, and Quartz Gems Occur, as taken from United States Geological Survey Report by Douglas B. Sterrett; a report on the Dan River Coal Field, by R. W. Stone, as reprinted from Bulletin 471-B of the United States Geological Survey; a special report on Graphite, by Edson S. Bastin and reprinted from Mineral Resources of United States for 1912; a special report on Asbestos describing both the Amphibole and Chrysotile varieties; a report on the Mount Airy Granite Quarry; special report on Sand and Gravel, giving Uses, Definitions of Various Sands, etc., the portion of a Bulletin on Feldspar and Kaolin of the United States Bureau of Mines, which relates to North Carolina, and which takes up in detail Occurrences, Methods of Mining, and Descriptions of Localities of Feldspar and Kaolin mines in North Carolina, prepared by Mr. A. S. Watts. In this Economic Paper are also given the names and addresses of producers of the various minerals during the years covered by the report.

35. Good Roads Days, November 5th and 6th, 1913, compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary. 8°, 102 pp., 11 pl. *Postage 10 cents.*

36. Proceedings of the North Carolina Good Roads Association, held at Morehead City, N. C., July 31st and August 1, 1913. In Coöperation with the North Carolina Geological and Economic Survey.—Statistical Report of Highway Work in North Carolina during 1912. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary. 8°, 127 pp., 7 figs. *Postage 10 cents.*

37. Forest Fires in North Carolina during 1913 and a Summary of State Forest Fire Prevention in the United States, by J. S. Holmes, Forester, 1914. 8°, 82 pp. *Postage 8 cents.*

38. Forms covering the Organization of Drainage Districts under the North Carolina Drainage Law, Chapter 442, Public Laws of 1909, and Amendments. And Forms for Minutes of Boards of Drainage Commissioners covering the Organization of the Board up to and Including the Issuing of the Drainage Bonds. Compiled by Geo. R. Boyd, Drainage Engineer. 133 pp.

39. Proceedings of the Good Roads Institute held at the University of North Carolina, March 17-19, 1914. Held under the auspices of the Departments of Civil and Highway Engineering of the University of North Carolina and the North Carolina Geological and Economic Survey. 8°, 117 pp., 15 figs., 4 pl. *Postage 10 cents.*

40. Forest Fires in North Carolina during 1914 and Forestry Laws of North Carolina, by J. S. Holmes, State Forester, 1915. 8°, 55 pp. *Postage 5 cents.*

41. Proceedings of Seventh Annual Drainage Convention of the North Carolina Drainage Association held at Wilson, North Carolina, November 18 and 19, 1914. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1915. 8°, 76 pp., 3 figs. *Postage 5 cents.*

42. Organization of Coöperative Forest Fire Protective Areas in North Carolina, being the Proceedings of the Special Conference on Forest Fire Protection, held as part of the Conference on Forestry and Nature Study, Montreat, N. C., July 8, 1915. Prepared by J. S. Holmes, State Forester, 1915. 8°, 39 pp. *Postage 4 cents.*

43. Proceedings of the Second Road Institute, held at the University of North Carolina, February 23-27, 1915. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1916. 8°, 128 pp. *Postage 15 cents.*

44. Highway Work in North Carolina During the Calendar Year Ending December 31, 1914. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1916. 8°, 55 pp. *Postage 10 cents.*

45. Proceedings of the Eighth Annual Drainage Convention. Held under the Auspices of the North Carolina Drainage Association and the North Carolina Geological and Economic Survey, Belhaven, N. C., November 29, 30, and December 1, 1915. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary. 8°, 90 pp. *Postage 15 cents.*

46. The Vegetation of Shackleford Bank, by I. F. Lewis, 1917. 8°, 40 pp., 11 pl. *Postage 10 cents.*

47. Proceedings of the Ninth Annual Drainage Convention of the North Carolina Drainage Association, held at Greensboro, N. C., November 22 and 23, 1916. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1917. 8°, 110 pp., 8 figs. *Postage 15 cents.*

48. Forest Fires in North Carolina during 1915, 1916 and 1917, and Present Status of Forest Fire Prevention in North Carolina, by J. S. Holmes, State Forester, 1918. 8°, 97 pp. *Postage 10 cents.*

49. Mining Industry in North Carolina during 1913-1917, Inclusive, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1919. 8°, 170 pp. *Postage 20 cents.*

Gives list of useful minerals of North Carolina; contains detailed report on the Uwarra Mill at Candor; data relating to the brown hematite iron ores and a special report on the titaniferous iron ores of the State; report on tin resources of the Kings Mountain District; special data relating to manganese; greensand; marble deposits of Cherokee County; clay tests.

50. Proceedings of Tenth Annual Drainage Convention, held at Washington, North Carolina, March 31 and April 1, 1920, compiled by North Carolina Geological and Economic Survey, 1920, 8°, 78 pp. *Postage 10 cents.*

#### VOLUMES

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy, \$1.50 extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Out of Print.*

Vol. III. The Coastal Plain Deposits of North Carolina, by William Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson, and Horatio N. Parker, 1912. 8°, 509 pp., 62 pl., 21 figs. *Out of Print.*

Pt. I.—The Physiography and Geology of the Coastal Plain of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller and L. W. Stephenson.

Pt. II.—The Water Resources of the Coastal Plain of North Carolina, by L. W. Stephenson and B. L. Johnson.



Vol. IV. The Birds of North Carolina, by T. Gilbert Pearson, C. S. Brimley and H. H. Brimley, 1918. 8°, 380 pp., 24 colored plates, 10 black and white plates, 275 text figures, one map. *Paper copies, \$2.00, postpaid. Cloth-bound copies, \$2.75, postpaid.*

## BIENNIAL REPORTS

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving object and organization of the Survey; Investigations of Iron Ores, Building Stone, Geological work in Coastal Plain Region, including supplies and drinking waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Contains Special Report on an examination of the Sand Banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Coöperation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work, with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of Special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry Reports relating to Connolly Tract, Buncombe County and Transylvania County State Farms; certain Watersheds; Reforestation of Cut-over and Abandoned Farm Lands on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county seats of North Carolina; list of Magnetic Declinations at the county seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Biennial Report, 1911-1912, Joseph Hyde Pratt, State Geologist, 1913. 8°, 165 pp. *Postage 7 cents.*

Administrative report, and contains reports on method of construction and estimate of cost of road improvement in Stantonsburg Township, Wilson County; report on road conditions in Lee County; report on preliminary location of section of Spartanburg-Hendersonville Highway between Tryon and Tuxedo; report of road work done by United States Office of Public Roads during biennial period; experiments with glutrin on the sand-clay road; report on Central Highway, giving Act establishing and report of trip over the Highway; suggested road legislation; report on the Asheville City watershed; report on the Struan property at Arden, Buncombe County; report on the Woodlands on the farm of Dr. J. W. Kilgore, Iredell County; report on examination of the woodlands on the Berry place, Orange County; report on the forest property of Miss Julia A. Thorns, Ashboro, Randolph County; report on the examination of the forest lands of the Butters Lumber Company, Columbus County; proposed forestry legislation; swamp lands and drainage, giving drainage districts; suggested drainage legislation; proposed Fisheries Commission Bill.

Biennial Report, 1913-1914, Joseph Hyde Pratt, State Geologist, 1915, 8°, 118 pp. *Postage 10 cents.*

Administrative report and contains reports on the work of the State convicts on Hickory Nut Gap Road, Henderson County, and on the link of the Central Highway in Madison County which is being constructed with State convicts; report on road work accomplished by the State Survey and by the United States Office of Public Roads during biennial period; suggested road legislation; a forestry policy for North Carolina; report on investigation. Timber supply of North Carolina; reports on the examination of certain forest lands in Halifax County; report on the ash in North Carolina; report on the spruce forests of Mount Mitchell; report on the forest fire conditions in the Northeastern States, by J. S. Holmes. Report on the work of the United States Forest Service in North Carolina in connection with the purchase of forest reserves and their protection; timber tests, including strength of timber, preservation of timber, timber suitable to produce pulp, distillation of certain woods and drying certain woods; suggested forestry legislation; report on the swamp lands and their drainage in North Carolina; suggested drainage legislation, report on magnetic observations made during biennial period; report on the economic value of the fisheries of North Carolina; report on the survey made in Albemarle, Croatan, and Pamlico sounds by the Coast and Geodetic Survey; suggested fisheries legislation.

Biennial Report, 1915-1916, Joseph Hyde Pratt, State Geologist, 1917. 8°, 202 pp. *Postage 25 cents.*

Administrative report and contains special reports on the Protection from Fire of the Forested Watersheds of Navigable Streams; National Forest Reservations; forestry report on Lake Latham Farms near Mebane, N. C.; report on Forest Tract owned by the Cranberry Iron and Coal Company near Cranberry, N. C.; report on work of N. C. Forestry Association; report on Southern Forestry Congress; special report on "The Fisheries of North Carolina"; Magnetic Observations made during 1915 and 1916; Memorial Sketch of Dr. Joseph Austin Holmes.

Biennial Report, 1917-1918, Joseph Hyde Pratt, State Geologist, 1919. 8°, 110 pp. *Postage 15 cents.*

Administrative Report, and contains special reports on the Mitchell State Park; Proposed Forestry Course at the State University; North Carolina Forestry Association; report on magnetic observations made during biennial period.

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Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS OR QUANTITATIVE DETERMINATIONS WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, postoffice address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

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